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Summary of Progress *of the* GEOLOGICAL SURVEY OF GREAT BRITAIN *and the* Museum of Practical Geology for the Year 1933

PART I

LONDON
PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
1934
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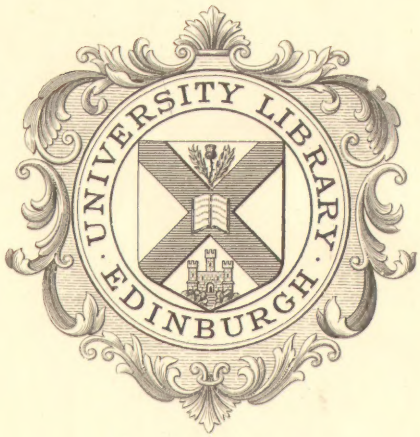

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Summary of Progress

of the

Geological Survey of Great Britain

and the

Museum of Practical Geology

for the Year 1933

PART I

With Report of the
Geological Survey Board and
Report of the Director

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REPORT OF THE GEOLOGICAL SURVEY BOARD FOR 1933

TO THE LORDS OF THE COMMITTEE OF THE PRIVY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

MAY IT PLEASE YOUR LORDSHIPS.—

In accordance with our terms of reference, we, the Geological Survey Board, beg leave to submit our Fourteenth Annual Report on the work of the Survey and Museum.

Field Work

The Director's Report for 1933 which is submitted herewith shows that although some work was carried out in all the areas laid down in the programme for the year, field work was of necessity restricted owing to several of the geological surveyors being engaged in the preparation of exhibits for the new Museum. These officers made many visits to the field in connexion with this work. The chief districts examined are named in the Director's Report (p. 12).

The first revision of the Scottish Coalfields is now almost completed and the primary mapping on the six-inch scale of the Forest of Dean Coalfield has been commenced.

The Field Units were engaged in the undermentioned districts:—

Southern District (primary six-inch survey).

West Midlands and Cambridge Districts (primary six-inch survey).

Yorkshire District (revision of six-inch survey).

Lancashire District (revision of six-inch survey).

Cumbrian District (revision of six-inch survey) and Forest of Dean (primary six-inch survey).

Northumberland and Durham District (revision of six-inch survey).

Dumfriesshire and Ayrshire (revision of six-inch survey).

Central Coalfield and Fife (revision of six-inch survey).

West Highland District (primary six-inch survey).

Shetland (primary six-inch survey).

Details of the work carried out by each of the Field Units mentioned above are given in the *Summary of Progress* (pp. 41-76).

Preparations for the Occupation of the New Survey Offices and Museum at South Kensington

It had been expected that the new building in Exhibition Road, South Kensington, would be ready for handing over by H.M. Office of Works about the end of March, 1933, and arrangements had been made accordingly to commence the removal of the offices and collections as soon after that date as possible.

The decision of the Government to convene an International Monetary and Economic Conference to be held in London, and to use the new buildings of the Survey and Museum for this purpose, completely altered the programme.

The Conference sat until the end of July. In November, H.M. Office of Works commenced to dismantle the fittings which had been erected for the purposes of the Conference and to repaint the interior of the Museum.

So much progress was made that it was announced that the removal of the Offices could start at the beginning of 1934, to be followed later by the library and collections.

A small Committee has been set up by the Advisory Council to arrange a programme for the combined Centenary Celebrations of the Survey and the Formal Opening of the Museum in June, 1935.

Publications

The publication of maps, memoirs and vertical sections continues on the same scale as in previous years.

The quarter-inch maps of England and Wales are being issued in a revised colour-printed scheme. At the present date eleven sheets have been replaced.

The six-inch coalfield maps are principally from Lancashire and Yorkshire. The publication of a series of colour-printed six-inch maps of the London District, which is a completely new departure, is making rapid progress. This innovation will enable the public to purchase inexpensive sheets of this area which have previously only been obtainable at the cost of hand-drawing and hand-colouring.

In Scotland three one-inch maps have been issued, the most important being the Solid and Drift editions of the South Ayrshire Coalfield map. A Soil edition of this sheet was published in 1932.

Several small scale maps showing the distribution of economic minerals are in progress.

The memoirs published during the year were descriptive of the following areas:—Holmfirth and Glossop, Reigate and Dorking, Cirencester, Merthyr Tydfil (revised edition), Torquay (revised edition), and the Bo'ness Coalfield.

The results of the extensive investigations carried out in recent years in the concealed coalfield of Kent were published as three papers in Part II of the *Summary of Progress* for 1932.

Agriculture, Soil Mapping and Forestry

The Geological Survey has continued to maintain close co-operation with the agriculturists and soil experts of the Soils Correlation Committee of the Ministry of Agriculture and Fisheries in conjunction with the Department of Agriculture for Scotland, and in collaboration with the Harper Adams Agricultural College has been considering a system of colouring for soil maps.

A geological surveyor visited the Bromham area near Chippenham with the Agricultural Adviser to the Bristol District regarding the suitability of that neighbourhood for market gardening. The same officer also attended a meeting of the Soils Correlation Committee held in connexion with the British Association.

As in previous years, reports on samples have been furnished to the Forest Products Research Laboratory in connexion with the investigation of properties of timber grown on different soils in Great Britain.

Investigation of Building Stones

Co-operation with the Building Research Station regarding building stones was continued and assistance has also been given to outside bodies in the determination of stones suitable for building purposes.

Geophysical Work

No geophysical work was carried out during the year, but in response to a request from the British Association (Section C) an officer of the Museum gave a demonstration on the use of geophysical methods in the field. The Director presided over meetings of the Geophysical Committee of the International Geological Congress held in Washington, U.S.A.

Fuel Research

Geological information has continued to be given by officers of the Survey to the district committees of the Fuel Research Station.

Water

An officer of the Geological Survey served on a committee of the British Association on Inland Water Survey and assistance has been given to the Water Pollution Research Board in connexion with the investigation into the pollution of the Mersey Estuary.

Conferences

The Director and Professor C. Gilbert Cullis attended the International Geological Congress which met at Washington, U.S.A., as British Government Delegates.

Death of Mr. E. G. W. Elliott

We have to record, with deep regret, the death on the 16th April, 1933, of Mr. E. G. W. Elliott, Assistant Librarian to the Geological Survey and Museum, who had acted as Secretary of the Geological Survey Board for many years. We desire to express our appreciation of the high value of the services which Mr. Elliott rendered to the Board.

Programme for 1934

The programme of field work approved for 1934 is:—

(a) primary mapping on the six-inch scale in Shetland, Inverness-shire, Forest of Dean, Droitwich, Sevenoaks, Bridport, Biggleswade and Huntingdon;

(b) revision of original six-inch mapping in the following coalfields and adjacent areas:—Northumberland, Lancashire, Yorkshire, Fife, and Stirling;

(c) investigation of underground water-supplies, examination of mineral resources, verification of bore records, and collaboration with soil-surveys;

(d) collection of Museum specimens, photographing of geological subjects for enlargement, field work in connexion with the designing and execution of panoramas for the new Museum.

As it will probably be necessary to keep several of the field surveyors at Headquarters to prepare Museum exhibits during the field season, the field programme may be of necessity much restricted.

T. Franklin Sibly,
Chairman.

21*st March*, 1934.

SUMMARY OF PROGRESS OF THE GEOLOGICAL SURVEY AND MUSEUM FOR 1933

I. REPORT OF THE DIRECTOR

THE work of the Geological Survey and Museum during 1933 was in some respects different from what had been anticipated when the programme was laid down. It had been expected that the new Museum in Exhibition Road, South Kensington, would be completely equipped by H.M. Office of Works and handed over to the Geological Survey about the end of March, 1933. The removal of offices, records, library and collections was to begin in April and was to be completed by the end of September. The task of preparing the new Museum for opening to the public, which would necessarily involve several months' arduous work, could then be taken in hand and probably would have been completed early in 1934.

Unforeseen circumstances intervened, however, because in February it was announced that the Government intended to convene an International Monetary and Economic Congress in London, to which representatives of all the principal nations would be invited. Search was made for a suitable building in which to hold the Conference, and it was soon decided that the new Museum and the Geological Survey offices were eminently suitable, and could readily be adapted for this purpose. The accessibility, and ample space provided by this building were unequalled, and in the event the choice was justified. Preparations were at once begun by H.M. Office of Works. Little change was necessary in the offices, laboratories and libraries. These were occupied by the Foreign and Empire representatives, their secretarial staffs, the interpreters and the necessary personnel of the League of Nations, under whose auspices the Conference was held. The Museum, however, was completely transformed, so far at least as concerns its internal arrangements. A large auditorium, providing nearly 1,000 seats, was created on the main floor of the building. Two committee rooms, each seating about 350, were formed on the first and second galleries. Restaurants, lounges, smaller committee rooms and retiring rooms were provided in other parts of the Museum. In the basement, accommodation was made for the newspaper press, the telegraphic and telephonic installations, the enquiry bureaus, cloak rooms, typists and stenographers, and a special buffet for the press correspondents. The arrangements worked perfectly smoothly and the new Museum was the scene of great activity during the whole summer.

At the end of July, the Conference disbanded and the Museum was for a time unoccupied. In November, however, it was announced that if the Conference met again in London the new Museum would not be required for that purpose. The Office of Works immediately proceeded to remove the fittings installed for the purpose of the Conference. The interior of the Museum was re-painted and the installation of library and laboratory fittings for the Geological Survey was begun. According to programme this work was intended to be so advanced by the end of 1933 that the removal of Geological Survey offices and laboratories could be started in January, 1934. It is anticipated that the transfer of the Library may begin in March, and the collections housed in the old Museum in Jermyn Street may follow during the summer of 1934.

A good deal of work has been done in preparing exhibits, photographs, diagrams, maps, etc., for the new Museum, but necessarily these preparations cannot be completed till space is available. The accommodation in the Jermyn Street building is so limited and the space is so densely filled with the collections of the Geological Survey that progress is impeded. The furniture for the new Museum, however, is nearly all ready to be placed out on the floors and galleries, and has been stored meanwhile on the top floor at Exhibition Road, so that on the completion of the equipment of the main floor and galleries of the new building it can readily be transferred to its permanent quarters.

As the Library of the Geological Survey in Jermyn Street is much used by students, geologists and engineers, it has been decided that, when the Museum is closed for the packing and transfer of the collections, the door which opens in Piccadilly will be used by those who wish to consult the books and maps in the Library. Moreover, during the period which elapses between the closing of the Library in Jermyn Street and the opening of the new Library at South Kensington, members of the public who wish to consult the published maps and memoirs of the Geological Survey will have an opportunity to do so at the Library of the Geological Society of London in Burlington House. This privilege has been very kindly granted by the Council of the Geological Society and will be much appreciated by the public in search of geological information.

At as early a period as possible the offices and laboratories of the Geological Survey will be in working order in South Kensington and only a small portion of the staff, especially concerned in the packing and registration of books and specimens, will be at work in the Jermyn Street building.

Museum of Practical Geology

As the Jermyn Street Museum will open its doors to the public for the last time at the end of the year 1933, a brief outline of its history may here be given. It was opened in the year of the Great

Exhibition of 1851. Previous to that date the collections of the Geological Survey, under the auspices of Sir Henry Thomas De la Beche, had been housed in an old building in Craig's Court. The collections had far outgrown the space available for them and De la Beche brought forward the proposal to erect a new Museum which would accommodate not only the Geological Survey but also the Royal School of Mines, which was to be a centre for training mining engineers and geologists. The proposal was warmly received and had the support of His Royal Highness the Prince Consort, who took a special interest in it. Plans for the building were prepared by Pennethorne and the permanent lease of a site in Piccadilly was obtained from the Office of Woods and Forests. The building was opened on May 12th, 1851, by the Prince Consort, in the presence of a very distinguished assemblage of politicians, administrators and scientists. In commemoration of this ceremony the busts of Queen Victoria and the Prince Consort have always been exhibited on the ground floor of the Museum in the entrance hall.

The stone used for the erection, especially the Piccadilly front, was the famous dolomitic limestone of Anston, near Mansfield. This had been used, on De la Beche's advice (though it was not the stone primarily selected), for the new Houses of Parliament. A glance at the Piccadilly face of the Museum will show how well this stone has resisted the attack of the corrosive agencies that characterise the atmosphere of London. In this respect it contrasts very strongly with the state of the Houses of Parliament. The explanation is said to be that De la Beche secured that every stone should be examined and passed in the quarry by a competent inspector before it was sent to London. Had similar precautions been taken at St. Stephen's the result might have been very different.

The new institution became very popular and soon achieved a world-wide reputation for the excellence of its training and the high standing of its professorial staffs. For many years it continued to be the great centre of mining education in Great Britain and was in no respect inferior to the famous schools of Paris and Freiburg. Among its Directors and Professors it numbered such names as Sir Henry De la Beche, Sir Roderick Murchison, Sir Andrew Ramsay, Sir Lyon Playfair, Professor Huxley, Edward Forbes, Professor Hofmann, Professor Tyndall and Dr. Percy. There are still many distinguished mining engineers who look back to the old school in Jermyn Street with affection and gratitude.

In 1872, the Royal School of Mines was transferred to South Kensington, where in 1907 the present magnificent premises were erected for the School and the Imperial College of Science.

For a number of years the Mining Record Office was also connected with the Museum. This office compiled statistics of the output of minerals from British Mines and in 1883 was taken over by the Mines Department of the Home Office (now Board of

Trade) which now performs its functions. The Jermyn Street building proved too small for the staffs and students, and two houses in Jermyn Street were leased for the Geological Survey and the Mining Record Office. One of these houses was occupied by the Geological Survey till 1900 when the ground was taken over by the Popular Café, which, however, let one of its upper floors to the Geological Survey staff.

There seems to be a widespread belief that the ornamental work of the Jermyn Street doorway to the Museum was designed by Alfred Stevens, and the late Lord Balfour was concerned to know whether it was not possible to preserve that structure, but I had to inform him that so far as the documents in our possession showed, the design was the work of Pennethorne. On good authority it is stated that Stevens 'designed bronze doors for the Geological Museum in Jermyn Street' (*British Painting* by C. H. Collins Baker, Surveyor of the King's pictures, London, 1933, p. 194), but it must be admitted that the doors in question are not of bronze but of wood, and consequently Stevens' design can never have been carried into execution.

The plans for the Museum were very carefully criticised by De la Beche and several versions of them are preserved. The building was completed in 1851, having taken three years in erection, and in its external features has generally been regarded as worthy of the high reputation of the architect (*Architect,* September, 1933).

The ground floor, which was entered by a flight of steps from the Jermyn Street entrance, was 70 feet long by 65 feet broad. On the Piccadilly side were a library, offices and Director's room. The main hall was lighted by windows on the Jermyn Street front and by a well in the floor above. In this first floor which measured 95 feet by 54 feet, the large central well was surrounded by a horse-shoe case corresponding in shape to the curved northern end of the central opening. Above the first floor were two narrow galleries approached by staircases. The lighting of the upper part of the Museum was obtained partly by panes of glass in the arched roof and partly from a set of windows opening on to Jermyn Street.

This design was probably the best that could have been made in view of the restricted space on which the Museum was built and the impossibility of inserting windows on the sides of the building. The lighting of the interior, though never excessive, was sufficient under ordinary conditions except on the ground floor, which consequently was used mostly for the display of large specimens of ores, building stones, ornamental stones and models. The chief difficulty, however, was that, owing to the limited floor space, the exhibits had to be shown principally in vertical wall-cases which covered the whole of the walls from principal floor to ceiling. As an immense amount of material was placed in these cases, much of it was very imperfectly seen and the lighting of the wall-cases

left much to be desired. As an example of museum construction at the time when it was erected, the building was generally approved, and it was decided, for example, to erect a similar museum in Berlin for the Geological Survey of Prussia. That building, however, is by no means a replica of the Jermyn Street Museum, at any rate in its present state. It is interesting to note that the Museum of the Geological Survey of Spain in Madrid, opened by King Alfonso in 1926, repeats many of the features of the Jermyn Street Museum, but the conditions in Madrid are very different from those in London, as the intense heat and glaring light in summer render it necessary to secure a certain amount of shade.

Accommodation was provided for the Royal School of Mines principally on the top floors of the Piccadilly side of the building. Here Hofmann and Lyon Playfair had their chemical laboratory and Percy taught metallurgy. It is not known where Tyndall had his quarters, and Huxley seems, for a time at least, to have worked in one of the houses in Jermyn Street. The metallurgical and assaying laboratories were placed in the basement. The Geological Survey offices, as already stated, were in a house in Jermyn Street, on the west side of the Museum. This arrangement lasted practically till the School of Mines took its departure in 1872 for South Kensington.

The professors delivered lectures in a large lecture hall, almost semicircular in shape, which occupied the central part of the basement and main floor. It was covered with a glass roof, which filled the interior of the horse-shoe shaped opening on the first floor. This lecture hall was used also for a very famous series of scientific lectures to working men, delivered mostly by the professors of the Royal School of Mines. The hall could seat nearly 600 persons, and tickets for these lectures were ardently sought for. When it is remembered that the lecturers were such men as Huxley, Tyndall, Ramsay, Percy and Lyon Playfair it will be understood that they attained a high level of excellence. At a later period the hall was used also for the ordinary meetings of scientific societies. Its use was not discontinued till the end of the century.

It should be remembered that at that time, though the accommodation was small, it was sufficient, because the majority of the Geological Survey staff resided permanently in or near the district which they were mapping and came to London only for short periods at long intervals.

When the Jermyn Street Museum was opened it was intended to exhibit geology, the work of the Geological Survey, the applications of geology to arts and industry, mining engineering, metallurgy and mine surveying. The ground floor, restricted in area owing to the fact that half of it was devoted to the lecture hall, had exhibits of building stones, ores, ornamental stones, slates and statuary, but as the lighting was bad it was not really of much use. The walls were lined with ornamental marbles. On the first floor the

horse-shoe case was filled with attractive specimens of minerals, crystals, cut gem stones, semi-precious stones, carvings, cups and vases in agate, onyx, jade, alabaster, etc., and remained in very much the same condition till the Museum closed in 1933. In the vertical cases on the walls, and in the table cases on the floor, there were exhibits of British and foreign minerals, and ores, veinstones, and all sorts of specimens to illustrate economic mineralogy and metallurgy. This part of the Museum was arranged by the first Curator, Trenham Reeks, no doubt under the supervision of De la Beche and Percy. At the Jermyn Street end of this floor there was a series of cases showing pottery (mostly British) and ceramics generally. As may be seen from the Catalogue, this collection was of great interest and variety, and the Catalogue is still in request by connoisseurs. About the year 1900 it was dispersed, as not being suitable for a Museum of geology, and it is now scattered among different museums such as the Victoria and Albert Museum, Bethnal Green Museum, etc. At the other end of this floor two rooms looking out on Piccadilly contained models of mines and mining apparatus.

The vertical cases which ran around the first and second galleries were adapted to take a representative series of British fossils, stratigraphically arranged according to the various geological formations and their principal subdivisions. The records seem to show that the fossils were selected and arranged by Edward Forbes and Professor Huxley, and from a very early period these cases were well filled with coloured drawings of fossils.

After a time the demand for more space became insistent and additional table-cases (with drawers beneath) were fastened on the top of the balustrade that ran around the galleries. Although many modifications were made in these exhibits in course of time, this arrangement remained substantially little altered till the closing of the Museum.

At the Jermyn Street end of the topmost gallery a room of considerable size was devoted to petrology and a large exhibit of British rocks was set out, primarily by Sir Andrew Ramsay and Sir Archibald Geikie, though it had been much increased and improved by the efforts of Frank Rutley.

Quite a considerable number of the more striking exhibits that were placed on the Museum floors had come directly from the Great Exhibition of 1851 and can be traced in its catalogues. The giant statue of Hercules, for example, in Portland stone, bears an inscription to that effect, and of the marble columns, the large granite and alabaster vases, the large specimens of native copper and the metallurgical exhibits, the major part was inherited from the Great Exhibition.

Of the more striking bequests, the Ludlam bequest of a collection of minerals numbering over fifteen thousand may be specially mentioned as the most valuable bequest which the Museum has received, also the Warne bequest of minerals, and there were many

smaller donations. The principal bequests of fossils were the Edgell collection, the Godwin Austen, Brodie, Fitton, Wetherell and Pengelly collections.

In 1872, on the erection of the new Science Schools at South Kensington, the chemistry, biology, and physics schools were transferred to their new quarters. Geology followed in 1877. Dr. Percy remained at Jermyn Street till 1880, tenaciously sticking to his former haunts. Sir Warington W. Smyth also gave lectures on Mining at Jermyn Street till 1890. The rooms vacated were for the most part handed over to the palaeontological department of the Geological Survey, though one room was given to the petrographer. The growth of the collections had reached such a point that a large part of the space available, both in the laboratories and in the basement, was required for reference storage.

The descriptive *Handbook to the Museum of Practical Geology*, of which the fifth edition was published in 1896, shows that comparatively little change was made in the exhibits or in their arrangement. About half the space on the ground floor and first floor was still given to models of mines, mining districts and mining machinery, metallurgical products, metals, pottery and ceramics. The horse-shoe case with its display of attractive minerals maintained its place. The galleries were given over to palaeontology, and the arrangement differed little from that which was installed by Huxley. Petrology and petrography were relegated to the Rock Room. The wall-cases on the first floor were occupied by ores and veinstones, British and foreign.

The next stage in the history of the Museum of Practical Geology was reached in 1900, when Sir Archibald Geikie retired, and Sir Jethro Teall succeeded him as Director. It was then decided, on the recommendation of the Wharton Committee, to reorganize the Museum. The growth of science collections at South Kensington rendered it superfluous to exhibit the industrial applications of geology, and with the transference of the Royal School of Mines the collection of mining models and apparatus was more appropriate to the Science Museum than to the Jermyn Street Museum. Consequently these exhibits were dispersed. The mining models, machinery, metallurgy, etc., went to South Kensington to be used either for illustrating lectures or for exhibition in the rapidly growing Science Museum. The pottery and ceramics went partly to Bethnal Green Museum and partly to other public museums. The space thus set free was in part devoted to further illustrations of geology. A special series of British minerals was prepared by Mr. Rudler. The old Rock Room was transformed into a drawing office and the Model Rooms were turned into offices of the Geological Survey. At the same time the lecture hall was abolished and the space thus set free was sufficient to provide a Map Room (as an addition to the Library), additional storage in the basement and an extension of the exhibition space on the ground floor. The rock collection was now

exhibited in the cases formerly allotted to pottery and ceramics at the south end of the principal floor. A Short Guide to the collections as thus rearranged was published in 1909.

This condition of affairs lasted till the outbreak of War in 1914. Then the Museum was closed down. It was not opened again to the public till 1919 and no change was made in the arrangement of the exhibits or the disposition of the offices, library and laboratories. In 1921, however, during some repairs to the ceilings of the Museum, the staff of H.M. Office of Works discovered that certain iron beams in the roof were fractured. The Museum was at once closed, as being unsafe for the public, and wooden structures were built to support the north end of the roof. When these were completed it was discovered that the south end of the roof was also in a dangerous state and additional supporting structures were erected. Most of the glass in the roof was removed, and the whole roof was lightened by the substitution of wood for the slates and lead. For a time access to the library was provided by means of a special door opening into Piccadilly. When again opened to the public the Museum was most unsatisfactory, as daylight was almost excluded and the artificial lighting was a temporary makeshift. Both in the basement storage and in the Museum itself the timber structures that supported the roof proved obstructive and detrimental. The Library, offices and laboratories, however, continued in their former condition and the work of the Geological Survey went on as usual.

Various proposals were considered but no decision was taken till the Museums Commission met in 1927. After taking the evidence of the Director the Commissioners appointed a delegation to approach the Chancellor of the Exchequer and represent that immediate steps should be taken to transfer the Museum of Practical Geology to a new building in South Kensington. Space had already been allotted for this purpose in Exhibition Road by the Bell Committee's Report in 1912 and with the approval of the authorities the preparation of plans for a new Museum was at once put in hand by H.M. Office of Works. Sir Richard Allison and Mr. Markham were the architects in charge of the work and in 1929 the foundations of the new Museum were laid.

As already stated the building of the new Museum was completed in 1933.

Field Work

The amount of field work done in 1933 was of necessity somewhat less than usual as six or eight geologists were kept in the London Office during the field season preparing exhibits for the new Museum. Some work was done, however, in practically all the districts in which the Survey had been active during previous years and a new area was begun in the Coalfield of the Forest of Dean.

In the London area several geologists were busy collecting information for the preparation of a new series of colour-printed six-inch maps of London. Their duties were principally the verification of sites of borings and the inspection of recent exposures which had been made since the previous issues of the maps.

In the Sevenoaks Sheet (287) Mr. Buchan continued the mapping of the Tertiaries and Cretaceous, and in the Kent Coalfield, Mr. Dines and Dr. Crookall collected data from various borings and underground operations.

In the Meneage district, on the north side of the Lizard, the Director spent three weeks on field work. The new edition of the Lizard Sheet (359) is in the press and will embody a complete reversal of the former interpretation of the geology of the Meneage, based on the fossils discovered by Miss Lind Hendriks.

In the Bridport Sheet (327) Dorsetshire, Mr. Lloyd and Dr. Welch have continued the mapping of the Secondary rocks and have received valuable assistance in the field from Dr. W. D. Lang of the British Museum and Mr. L. Richardson.

The West Midlands unit is engaged in completing the mapping of the Forest of Wyre Coalfield, particularly in the Droitwich Sheet (182). The Dudley Sheet (167) which adjoins it on the North is completed and is being prepared for publication.

Mr. Eastwood, Dr. Trotter and Mr. Rose have started work in the Forest of Dean. This coalfield has never been mapped on the six-inch scale, though a large model of it, prepared by T. Sopwith, who was Commissioner for the Crown under the Dean Forest Mining Act, was formerly exhibited in the Museum of Practical Geology.

In the region surrounding Cambridge, Mr. E. E. L. Dixon has surveyed a considerable area in the Biggleswade Sheet (204). Only a limited amount of six-inch mapping had previously been carried out in this district.

In Yorkshire, Mr. Bromehead, with four geologists, has completed the six-inch revision of the Barnsley (87) and Wakefield (78) Sheets which contain a large part of the West Yorkshire coalfield. The six-inch maps are now being prepared for the engraver. They represent a very important coalfield area of which the existing maps are more than sixty years old. A beginning has also been made with the Bradford Sheet (69).

The Lancashire unit under Dr. W. B. Wright has completed the survey of the Wigan Sheet (84) which has involved an extraordinary amount of work owing to the numerous mines active and abandoned, of which the plans had to be carefully studied. Considerable progress has also been made with the Preston Sheet (75) which may be completed in 1934. The four Sheets now revised in Lancashire comprise more than two-thirds of the workable coalfield area.

The staff working from the Northumberland office in Newcastle-on-Tyne has been engaged in two areas, one containing the Scremerston Coal beds (Elsdon, Sheet 10) and the other containing Coal Measures (Morpeth and Tynemouth, Sheets 14 and 15). They are advancing southwards, having started at Berwick-on-Tweed, and are now revising the northern parts of the Great Northern Coalfield.

A special investigation was made of the relations of the Millstone Grit and Carboniferous Limestones in the Haltwhistle area, in which several members of the Cumberland and Northumberland staffs took part.

In Scotland the three summer months, May, June and July, as usual, were spent on Highland ground. Mr. Richey and his staff, assisted by Mr. Jones and Mr. Tonks from Lancashire, continued work on the Highland schists, granites, etc., of Morvern, Sunart and Ardnamurchan (Sheet 52).

Mr. Wilson with five geologists considerably advanced the primary survey of Shetland, including the outlying islands of Foula and the Fair Isle. Only a comparatively small unsurveyed area now remains, and the work may be finished in 1934.

It has been decided then to transfer some of the geologists working in Shetland to the Western Isles, and so complete the survey of Skye as early as possible. This area will be opened in 1934.

The first Coalfield revision in Scotland is almost completed and only a few six-inch maps remain to be published. Mr. Richey and his staff have finished the Sanquhar Coalfield and also the surrounding rocks that had not already been revised. New editions of the six-inch coalfield maps and also of the one-inch Sheet (15) are preparing for the press.

The East Fife or Leven Coalfield has now been completely revised. The maps are ready for the engraver and the descriptive economic memoir is being written.

Dr. Robertson and Mr. Haldane have been actively engaged in collecting information on the Kilsyth coalfield, and are preparing an Economic Memoir which will be the seventh and last of the Economic Memoirs on the Central Coalfield of Scotland.

Dr. John Pringle, with the assistance of Dr. Phemister in the determination of the igneous rocks, has done field work in the Jedburgh Sheet (17) and has prepared a new edition of that map which is now in the process of being engraved at Southampton.

Many visits to the field have been made by officers charged with the preparation of exhibits illustrating British regional geology for the new Museum. The districts examined include Assynt Mountains, Sutherlandshire, North Wales, Cornwall (china-clay region), Northamptonshire (iron ore fields), Yorkshire Coast, Durham Coast, Ballantrae and Girvan, Isle of Wight, Hampshire Basin, the Weald, East Anglia, and North Devon.

Publications

The List of Maps published during the year and of those in the press is given on pages 19-22.

Maps

The quarter-inch maps belong to a new issue by a revised colour-printing scheme. Of these eleven are now published; four are in the press or preparing for publication, and six or seven are not yet ready for the engraver.

No English one-inch coalfield map was published during the year, but two Northumberland maps are in the press (Solid and Drift editions of each) and several are being drafted in the Office, viz.: Wigan, Barnsley, Wakefield, Dudley, Cockermouth and the iron ore district of Gosforth (Cumberland).

The six-inch English coalfield maps are principally from Lancashire and Yorkshire. The Midland coalfields are almost completely revised, and the West of England (Bristol and Forest of Dean) coalfields have yet to be re-surveyed. One six-inch map from Northumberland was published, and several were in preparation.

In Scotland the principal one-inch coalfield maps of the year were the solid and drift editions of South Ayrshire (Sheet 14). A 'soil' edition of this Sheet had been issued in the previous year. The Scottish six-inch coalfield maps were five in number. The Stirlingshire maps are the revised edition, with some new information, and were published on new topographical Sheets referred to a new meridian, and consequently not fitting accurately to the adjacent Sheets of the revised edition which were issued on the old topography.

Two new maps of the Silurian areas of the South of Scotland were in progress. One includes the Sanquhar Coalfield (Sheet 15), and is not quite ready for engraving; the other represents the Hawick area (Sheet 17) and has been forwarded to the engraver. The one-inch maps of Shetland cannot be undertaken till the survey is completed. An interesting and important new map is the quarter-inch Sheet of the North-West Highlands (Sheet 5), which is engraved and is preparing for colour-printing.

Among other maps in preparation are several small-scale maps to show the distribution of economic minerals in England and Wales, such as coal, ironstone, limestone, lead, zinc, etc. As we are often asked to supply such maps for the use of conferences and committees it has been decided to publish a set of them as they may also be useful for teachers and students of geography.

Much work has been done by the drawing office staff in preparing diagrams, sketches, and large hand-coloured maps for exhibition in the new Museum.

Geological Maps of the London District

(Colour-printed on the scale of 6 inches to 1 mile)

For the last thirty years it has been the practice of the Geological Survey to publish colour-printed Geological Maps on the scale of one-inch to one mile; and for a still longer period the geology of certain areas, chiefly coalfields and their environs, has been issued in the form of uncoloured maps on the scale of six inches to one mile, which could be obtained hand-coloured if desired.

The publication of a series of 48 colour-printed maps of the London area on the six-inch to one mile scale, therefore, is an innovation—designed to meet a demand for inexpensive sheets showing the detailed geological information which hitherto could be obtained only by consulting the unpublished six-inch maps in the Library of the Geological Survey, or by securing hand-drawn and hand-coloured copies.

The new series, in which each map is 18″ by 12″ in size (representing six square miles), will cover London and its outskirts from Finchley and Woodford in the north to Surbiton and Croydon in the south; and from Ruislip and Hayes in the west to Ilford, Woolwich and Chislehurst in the east.

Of this Series, six have been published to date (February, 1934), namely: London 1 N.W., N.E., S.W., S.E., and 2 N.W. and N.E. These cover the areas about Wembley, Hendon, Neasden, Golders Green, Hampstead, Finchley, Hornsey, Wood Green, Tottenham and the Lea Valley.

The latest edition (1920) of the Ordnance Survey map has been used as a basis upon which to record the geology. The topographical details are printed in a greyish tint so that the geological notes and lines which are printed in black may be easily distinguished.

The geological survey of most of these six published sheets was carried out by Mr. C. E. N. Bromehead (1920-22), whilst the Lea Valley was mapped by J. Allen Howe (1902): recent modifications and additional notes have been made by Mr. Buchan (1932).

Geological boundaries and details are based upon a surface survey which includes the examination of natural or artificial cuttings and exposures; and on records of wells, borings and tunnels. The maps show by different colours the distribution of the various formations at the surface. London Clay exists over practically the whole area represented by the sheets now issued, and is covered locally by Claygate Beds and Bagshot Sands. On these formations there are the more recently deposited Glacial gravels, Boulder Clay and materials laid down by the Thames and its tributaries. Sites and detailed records of wells giving the thicknesses of the deposits in each case have been inserted, as well as notes of shallow excavations.

A generalised Vertical Section indicating the respective thickness of deposits penetrated by wells is provided at the margin of each map. These thicknesses of London Clay, Woolwich and Reading Beds, and Thanet Sand are of importance to the Engineer planning underground schemes (for example, tube railways). Levels of the surfaces of the London Clay and the Chalk relative to Ordnance Datum are also shown on the maps; hence the depth of Chalk from the surface at any chosen site can be calculated. This is of value since so large a part of London's water supply is obtained from the Chalk. Blue lines are used to indicate approximate courses of streams which in many cases are hidden from sight. Serious trouble has been caused in the foundations of buildings, in sewers, drains, etc., by such streams and their alluvial deposits, and for these reasons it has been thought necessary to indicate their distribution.

The maps should be useful to Civil and railway engineers, well sinkers, architects, surveyors, and others who will find information necessary for dealing with water supply, drainage, foundations, tunnelling, tube driving, etc.

To the geologist, the geographer and the archaeologist, the maps are likely to prove of scientific as well as of practical interest. In Central London many more records are available than appear upon the maps at present issued, and will be shown on the relevant sheets of the Series.

The price of each map is 2s. 6d.

Memoirs

Two coalfield memoirs were issued during the year, one on the Glossop area of Yorkshire, and the other a second edition of the Memoir on the Merthyr Tydfil district, completely revised and rewritten by Dr. Thomas Robertson. Several memoirs descriptive of the re-survey of the South Wales Coalfield are now out of print, but it has not been possible to assign Staff to revise the ground and prepare new editions of these memoirs during the past year.

Some important coalfield memoirs are being prepared for the press. Mr. Dinham is editing a memoir on the Shrewsbury area, Dr. W. B. Wright has in hand a memoir on the Wigan field, and two Yorkshire memoirs are to be written by Mr. Bromehead and his staff viz.: Barnsley and Wakefield. The field work in these areas is finished and the six-inch maps mostly published. The one-inch Shrewsbury map is published, but the Wigan, Barnsley and Wakefield one-inch maps are not yet drafted.

In Scotland one Economic Memoir on the Bo'ness coalfield was published; another on Central Fife is in the press; two others, on the Kilsyth coalfield and the Leven coalfield of Fife are being written but not yet ready for the printer. These very nearly complete the description of the revised survey of Scottish coalfields. A short account of the Sanquhar coalfield, of which the revision was recently completed will be published.

The Reigate map and memoir, published during the year, furnish an important contribution to the geology of the country around London. The Torquay Memoir also is of much interest to Geologists as the area is classic for students of the Devonian. It replaces the memoir written by Ussher on the revised survey of that district, which had been out of print for several years.

At the close of the year a memoir on the geology of the Orkney Islands by Mr. G. V. Wilson, had been sent to the printer, and it will be published during 1934.

Attention may here be directed to the fact that the extensive investigations carried on in the Kent Coalfield, by kind permission of the colliery firms, during recent years, have resulted in the publication of three Reports on the Stratigraphy, the Palaeobotany and the Palaeontology by Mr. Dines, Dr. Crookall and Dr. Stubblefield. These, taken together, form a practically complete account of our knowledge of the geology of this concealed coalfield, brought up to date by details of the most recent discoveries. As these materials did not seem appropriate for a Survey Memoir of the usual type, they were published in the *Summary of Progress* for 1932, Part II. Information is still being collected in this field whenever opportunity occurs, and further contributions will be published when different material has been obtained.

Water Supply Memoirs

No addition has been made to this series during the year, but Mr. L. Richardson has finished the manuscript of a memoir on the Wells and Springs of Herefordshire which will shortly go to the printer. Information is being actively collected on all aspects of the supply of underground water and some progress has been made in compiling a memoir on Lancashire. Owing to the dry season there have been numerous enquiries about water supplies, and this department of the Survey's work has been universally active. Several hundred enquiries have been answered.

The British Association Committee on Inland Water Survey has prepared a Report recommending the creation of a special Committee under the auspices of the Institution of Civil Engineers. Dr. Bernard Smith represented the Geological Survey on the British Association Committee and has kept in touch with the developments. So far as underground sources of water are concerned, the Geological Survey is the centre of information, and the data collected increase year by year. Although there is not as yet compulsory notification of borings in search of water, as there is in the case of borings and shafts for minerals, the engineers in charge very willingly contribute records and notes with specimens when requested, and the Survey officer who keeps the bore records visits every year a considerable number of new wells.

The Geological Survey has also been consulted by the Ministry of Health on many occasions with regard to the geological conditions affecting schemes of water supply that are under consideration, and the relative value of alternative proposals for obtaining additional supplies from underground sources.

The following maps, vertical sections and memoirs were published in 1933 :—

I.—Maps

English and Welsh Maps published in 1933

¼ inch to 1 mile :—

Sheet 16.—Cambridge, Colchester, Ipswich (*Solid, Revised*).
Sheets 20 with 24.—London, Dover, Brighton (*Solid and Drift, Revised*).

1 inch to 1 mile :—

Sheet 235.—Cirencester (*Drift*). Original survey on one-inch scale by E. Hull and published as Old Series sheets. Additions and revisions on six-inch scale by H. G. Dines assisted by notes by L. Richardson. Drift surveyed on six-inch scale by H. G. Dines; H. Dewey, District Geologist.

Sheet 316.—Fareham (*Drift, Revised and Reprinted*). Original survey on one-inch scale by H. W. Bristow, and published as Old Series sheets. Re-surveyed on six-inch scale by W. Whitaker, Clement Reid and C. E. Hawkins and published in 1905. Some revisions and additions by F. H. Edmunds in 1928.

6 inches to 1 mile (coalfield maps) :—

Lancashire, 84 N.E.—Bispham. Original survey by E. Hull. Resurveyed by Laurance H. Tonks; W. B. Wright, District Geologist.

Lancashire, 84 S.W.—Burscough. Original survey by E. Hull. Resurveyed by Laurance H. Tonks; W. B. Wright, District Geologist.

Lancashire, 84 S.E.—Parbold. Original survey by E. Hull. Resurveyed by Laurance H. Tonks; W. B. Wright, District Geologist.

Lancashire, 85 N.W.—Mossy Lea. Original survey by E. Hull. Resurveyed by Laurance H. Tonks; W. B. Wright, District Geologist.

Lancashire, 85 N.E.—Adlington. Original survey by E. Hull. Resurveyed by R. C. B. Jones; W. B. Wright, District Geologist.

Lancashire, 85 S.W.—Shevington. Original survey by E. Hull. Resurveyed by Laurance H. Tonks; W. B. Wright, District Geologist.

Lancashire, 85 S.E.—Standish. Original survey by E. Hull. Resurveyed by R. C. B. Jones; W. B. Wright, District Geologist.

Lancashire, 86 N.W.—Horwich. Original survey by E. Hull. Resurveyed by R. C. B. Jones; W. B. Wright, District Geologist.

Lancashire, 96 S.W.—Scot Lane End. Original survey by E. Hull. Resurveyed by R. C. B. Jones; W. B. Wright, District Geologist.

Lancashire, 92 N.W.—Ormskirk, S.E. of. Original survey by E. Hull. Resurveyed by Laurance H. Tonks; W. B. Wright, District Geologist.

Lancashire, 92 S.W.—Bickerstaffe. Original survey by E. Hull. Resurveyed by Laurance H. Tonks; W. B. Wright, District Geologist.

Lancashire, 94 N.W.—Aspull. Original survey by E. Hull. Resurveyed by R. C. B. Jones; W. B. Wright, District Geologist.

Lancashire, 94 N.E.—Chequerbent. Original survey by E. Hull. Resurveyed by R. C. B. Jones; W. B. Wright, District Geologist.

Lancashire, 94 S.E.—Atherton. Original survey by E. Hull. Resurveyed by R. C. B. Jones; W. B. Wright, District Geologist.

Lancashire, 100 N.W.—Simonswood. Original survey by E. Hull. Resurveyed by Laurance H. Tonks; W. B. Wright, District Geologist.

Lancashire, 100 N.E.—Rainford. Original survey by E. Hull. Resurveyed by R. L. Sherlock, and W. B. Wright; W. B. Wright, District Geologist.

Lancashire, 100 S.E.—Windle. Original survey by E. Hull. Resurveyed by R. L. Sherlock, and W. B. Wright; W. B. Wright, District Geologist.

Lancashire, 101 N.W.—Billinge. Original survey by E. Hull. Resurveyed by R. L. Sherlock, and W. B. Wright; W. B. Wright, District Geologist.

Northumberland, N.70 S.E.—North Blyth. Original survey by H. H. Howell. Revised by V. A. Eyles; R. G. Carruthers, District Geologist.

Yorkshire, 219 S.W.—Great and Little Preston. Original survey by J. C. Ward and R. Russell. Resurveyed by Wilfrid Edwards; C. N. Bromehead, District Geologist.

Yorkshire, 273 N.E.—Denby Dale, E. of. Original survey by J. C. Ward, J. R. Dakyns and A. H. Green. Resurveyed by C. N. Bromehead, District Geologist.

Yorkshire, 273 S.E.—Hoyland Swaine. Original survey by J. C. Ward, J. R. Dakyns and A. H. Green. Resurveyed by G. V. Wilson and C. N. Bromehead; C. N. Bromehead, District Geologist.

Yorkshire, 276 N.W.—Hooton Pagnell. Original survey by W. T. Aveline and A. H. Green. Resurveyed by G. H. Mitchell; C. N. Bromehead, District Geologist.

Yorkshire, 284 S.W.—Denaby Main, Conisburgh. Original survey by W. T. Aveline and A. H. Green. Resurveyed by G. H. Mitchell; C. N. Bromehead, District Geologist.

6 inch Maps (Colour-printed).

London N.1 N.W. (Middlesex 11 N.W.).—Kingsbury. Original survey by C. N. Bromehead. Additional notes by S. Buchan; H. Dewey, District Geologist.

London N.1 S.W. (Middlesex 11 S.W.).—Neasden. Original survey by A. C. G. Cameron; H. B. Woodward, District Surveyor. Revised by C. N. Bromehead. Additional notes by S. Buchan; H. Dewey, District Geologist.

London N.2 N.E. (Middlesex 12 N.E., Essex N.77 N.E.).—Tottenham. Original survey by J. A. Howe. Modifications and additional notes by S. Buchan; H. Dewey, District Geologist.

Scottish Maps published in 1933

1 inch to 1 mile:—

Sheet 9.—Maxwelltown (*Solid with Drift*). Original survey by A. Geikie, H. M. Skae, J. Horne and C. R. Campbell. Ordovician and Silurian revised by B. N. Peach and J. Horne. Post-Silurian by J. Pringle and J. E. Richey.

Sheet 14.—Ayr (*Solid*). Original survey by A. Geikie, J. Geikie and B. N. Peach. Ordovician and Silurian revised by B. N. Peach and J. Horne, Post-Silurian revised by E. B. Bailey, J. E. Richey, V. A. Eyles, J. B. Simpson and A. G. MacGregor; E. B. Bailey, District Geologist.

Sheet 14.—Ayr (*Drift*). Original survey by A. Geikie, J. Geikie and B. N. Peach. Ordovician and Silurian revised by B. N. Peach and J. Horne. Post-Silurian revised by E. B. Bailey, J. E. Richey, V. A. Eyles, J. B. Simpson and A. G. MacGregor; E. B. Bailey, District Geologist.

6 inches to 1 mile (coalfield maps):—

Fifeshire, 27 N.E.—Leslie (S. part of). Original survey by H. H. Howell. Revised by J. Knox.

Fifeshire and Kinrossshire, 27 S.W.—Auchterderran. Original survey by H. H. Howell. Revised by J. K. Allan; C. H. Dinham, District Geologist.

Stirlingshire, N.24 S.W.—Larbert and Stenhousemuir. Original survey by B. N. Peach. Revised by C. B. Crampton. Republished with additional information.

Stirlingshire N.24 S.E.—Grangemouth and Carronshore. Original survey by B. N. Peach. Revised by C. T. Clough and C. B. Crampton. Republished with additional information.

Stirlingshire N.30 N.W.—Camelon and Rough-Castle. Original survey by B. N. Peach. Revised by J. S. Grant-Wilson, C. B. Crampton and E. M. Anderson. Republished with additional information.

Manuscript copies of the following maps on the scale of six inches to one mile were deposited in the Library for public reference. They are not to be published. The English maps are deposited in the head office in London. These manuscript copies of unpublished maps may be examined in the Library of the Geological Survey on week-days from 10 a.m. to 5 p.m. Copies of them may be obtained at the cost of drawing and colouring, which will be quoted on application to the Superintendent of Maps. Photographs of these maps will also be supplied on the scale of 3 inches to one mile approximately, at the cost of 2s. 6d. to 3s. 6d. per quarter-sheet.

The Scottish manuscript copies which are deposited in the office at 19, Grange Terrace, Edinburgh, may on application be forwarded to the London Office for consultation.

Library Copies of English Manuscript Standard Maps Deposited for Reference

Berkshire, 23 N.W., S.W.; 26 N.W., N.E., S.W., S.E.; 45 N.W., N.E., S.W.,S.E.

Hampshire, 34 N.W., N.E., S.W., S.E.; 43 N.W., N.E., S.W., S.E.; 49 N.W., N.E., S.W., S.E.; 50 N.W.. N.E., S.W., S.E.; 51 N.W., N.E., S.W., S.E.; 52 N.W., N.E., S.W., S.E.; 53 N.W., N.E.; 59 N.W., N.E., S.W., S.E.; 67 N.W., N.E., S.W., S.E.

Lancashire, 91 N.E. (part), S.E. (part), 102 S.E.; 111 N.W., N.E., S.W., S.E,

Yorkshire, 259 S.W., 271 S.E.

Scottish Manuscript Maps Deposited for Reference

Buteshire, 203 N.W., N.E., S.W., S.E.; 204 N.W., N.E., S.W., S.E.; 214 N.E.; 215 N.W., N.E., S.W., S.E.; 258A N.E.; 259 N.W., N.E.; 260 N.W.

Caithness, 2 N.E. and 2A S.E.; 3 N.W. and 3A S.W.

Orkney, 70 S.E.; 71 N.W., S.W.; 72 N.E., S.E.; 73 N.W. and 73A S.W.; 74 N.E. and 75 N.W., N.E., S.W., S.E.; 76 N.W., S.W.; 77 N.E., S.E.; 78 N.W., N.E., S.W., S.E.; 79 N.W., N.E., S.E.; 80 N.W., N.E., S.W., S.E.; 81 N.E., S.W., S.E.; 82 N.W., N.E., S.W.; 83 N.W. and 78A S.W.; 84 N.E., S.E.; 85 N.W., S.W., S.E.; 86 N.W., N.E., S.W., S.E.; 87 N.W., N.E., S.W.; 88 N.W., N.E., S.W., S.E.; 89 N.W., N.E., S.W. S.E.; 90 N.W., N.E., S.W., S.E.; 91 N.E., S.W.; 94 N.W., N.E., S.W., S.E.; 96 N.W., N.E., S.W., S.E.; 108 N.W., N.E., S.W., S.E.; 110 N.W., S.W.; 116 N.W., S.W.; 118 N.W., N.E., S.W., S.E.; 119 N.W., N.E., S.W., S.E.; 122 N.W., N.E., S.E.; 123 N.W., N.E., S.W., S.E.; 124 N.W., N.E., S.W., S.E.; 125 N.E.; 126 N.W., N.E.; 127 N.E.

List of Maps in the Press at the Close of 1933

English Maps in the Press

¼ inch to 1 mile :—

Sheet 7.—Leeds, Manchester, York (*Solid, new edition*).
Sheet 14.—Aberystwyth, Carmarthen, Hereford (*Solid, new edition*).

1 inch to 1 mile :—

Sheet 9.—Rothbury (*Solid, new edition*).
Sheet 9.—Rothbury (*Drift, new edition*).
Sheet 10.—Woodhorn (*Solid, new edition*).
Sheet 10.—Woodhorn (*Drift, new edition*).
Sheet 359.—Lizard (*Drift, new edition*).

6 inches to 1 mile :—

Cheshire, 11 N.E.
Lancashire, 83 N.E., S.E.; 91. N.E., S.E.; 93 N.W., N.E., S.W.; 100 S.W.; 101 S.W., S.E.; 108 N.E.; 109 N.W.
London, N.1., N.E., S.E.; N.2 N.W., S.W., S.E.; N.3 N.W., N.E.; N.4 N.W., N.E., S.W., S.E.; N.5 N.W.N.E.; N.6 N.W.; N.8 N.E.
Yorkshire, 218 N.E., S.E.; 219 S.E.; 281 S.E.

Scottish Maps in the Press

¼ inch to the mile :—

Sheet 5.—Sutherlandshire, Caithness (West), and Ross and Cromartyshire (North-West).

1 inch to 1 mile :—

Sheet 17.—Jedburgh (*Solid with Drift*).

6 inches to 1 mile (coalfield maps) :—

Dumfriesshire, 6 S.W.
Fifeshire, 28 N.W.
Lanarkshire, 8 N.W.

II.—Vertical Sections of Strata

Scottish Vertical Sections published in 1933

Sheet 21.—Vertical Sections illustrating the Fife Coalfields. Area II Cowdenbeath, Leslie and Kirkcaldy districts.

III.—Memoirs

English Memoirs Published in 1933

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1932:—

Part I.—With Report of the Geological Survey Board and Report of the Director. 97 pp. 1933. Price 2*s. net.*

Part II.—142 pp., 10 plates, 27 text-figures. 1933. Price 3*s. net.*

The Geology of the Meneage. By Sir John S. Flett, K.B.E., F.R.S.

Contributions to the Geology of the Kent Coalfield:

(I) The Sequence and Structure of the Kent Coalfield. By H. G. Dines, A.R.S.M., A.M.Inst. C.E.

(II) The Fossil Flora of the Kent Coalfield. By R. Crookall, D.Sc., Ph.D.

(III) Notes on the Fauna of the Coal Measures of Kent. By C. J. Stubblefield, Ph.D., A.R.C.Sc.

The Gault of Cambridgeshire. By E. E. L. Dixon, B.Sc., A.R.C.Sc.

Composite Auto-intrusion in a Carboniferous Lava Flow. By W. Q. Kennedy, D.Sc.

The Lower Ordovician Graptolite Faunas with especial reference to the Skiddaw Slates. By Gertrude L. Elles, D.Sc.

The Fauna of the Palaeozoic Rocks of the Little Missenden Boring. By S. H. Straw, M.Sc., F.G.S., with a Report on the Fish Remains by Sir Arthur Smith Woodward, LL.D., F.R.S.

The Geology of the Country around Holmfirth and Glossop. (Explanation of one-inch Sheet 86; England and Wales). By C. E. N. Bromehead, B.A., Wilfrid Edwards, M.A., D. A. Wray, Ph.D., M.Sc., and J. V. Stephens, B.Sc., B. Eng. With Notes by G. V. Wilson, B.Sc., and W. Lloyd, B.Sc. 209 pp., 5 plates, 18 text-figures. 1933. Price 4*s. net.*

The Geology of the South Wales Coalfield. Part V. The Country around Merthyr Tydfil. (Explanation of one-inch Sheet 231: England and Wales). By Aubrey Strahan, M.A., F.R.S., F.G.S., Walcot Gibson, B.Sc., F.G.S., and T. C. Cantrill, B.Sc. *Second Edition* by T. Robertson, B.Sc., Ph.D., A.Inst.M.M., with a Palaeobotanical Chapter by R. Crookall, D.Sc., Ph.D. 283 pp., 6 plates, 51 text-figures. 1933. Price 5*s.* 6*d. net.*

The Geology of the Country around Reigate and Dorking. (Explanation of one-inch Sheet 286: England and Wales). By H. G. Dines, A.R.S.M., A.M.Inst.C.E., and F. H. Edmunds, M.A., with notes by C. J. Stubblefield, Ph.D., A.R.C.Sc. Palaeontology by C. P. Chatwin, M.Sc. 204 pp., 5 plates, 15 text-figures. 1933. Price 4*s. net.*

The Country around Cirencester. (Explanation of one-inch Sheet 235: England and Wales). By Linsdall Richardson, F.R.S.E. With contributions by Professor J. A. Hanley, A.R.C.Sc., Ph.D., and H. G. Dines, A.R.S.M. 119 pp., 7 plates, 5 text-figures. 1933. Price 3*s. net.*

The Geology of the Country around Torquay. (Explanation of one-inch Sheet 250: England and Wales). By W. A. E. Ussher, F.G.S. *Second Edition* (revised). By W. Lloyd, B.Sc., with Palaeontology by C. P. Chatwin, M.Sc., and a Chapter on the Petrography of the Igneous Rocks by W. G. Shannon, D.Sc., F.G.S. 169 pp., 7 plates, 20 text-figures. 1933. Price 4*s. net.*

Scottish Memoirs Published in 1933

Summary of Progress. See page 23.

The Economic Geology of the Central Coalfield. Area III. Bo'ness and Linlithgow. By M. Macgregor, M.A., D.Sc., and D. Haldane, B.Sc. 128 pp., 1 plate, 11 text-figures. 1933. Price 3*s. net.*

English Memoirs in the Press at the Close of 1933

List of Memoirs, Maps, Sections, etc. Published by the Geological Survey of Great Britain and the Museum of Practical Geology to 31st December, 1933.

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the year 1933. Part II.

Scottish Memoirs in the Press at the Close of 1933

Economic Geology of the Fife Coalfield. Area II. Cowdenbeath and Central Fife.

The Geology of the Orkneys.

Staff Changes

One resignation from the staff of the Geological Survey during the year 1933 arises from the appointment of Dr. T. N. George as Professor of Geology in University College, Swansea. The vacancy thus created has not yet been filled.

By the death of Mr. E. G. W. Elliott, after a short illness, on 16th April, 1933, the Geological Survey and Museum has suffered a severe loss. Mr. Elliott had served as Clerk and Staff Clerk, and since July 1st, 1929, as Assistant Librarian. He was also Secretary to the Geological Survey Board and in all his work was a most enthusiastic and competent Civil Servant who was regarded by all his colleagues with the greatest possible esteem.

Geophysical Work

No geophysical investigations have been carried out during the past year on behalf of the Geological Survey, but Dr. Hallimond, in the course of some non-official work, had occasion to make an extensive series of tests on a British magnetometer as the result of which he suggested certain alterations which improved its performance in the field for the special purposes for which it was being used. Our geophysical instruments are still on loan to the Imperial College of Science at South Kensington.

The Director presided over the meetings of the Geophysical Committee of the International Geological Congress at its meeting in Washington in September.

A paper on ' Laboratory determinations of the susceptibility of certain rocks ' by Prof. E. Herroun and Dr. Hallimond has been published in the *Proceedings of the Royal Society of London,*

Ser.A, Vol.141, p.302, 1933. Rock specimens for this work were collected by the Geological Survey. In response to a request from the British Association (Section C) Dr. Hallimond gave a demonstration of the use of geophysical methods in the field, over the ground surveyed by officers of the Survey in 1929-30.

Agriculture and Soil Mapping

The officers of the Geological Survey continue to maintain close co-operation with the agriculturists and soil experts working on soil classification under the auspices of the Ministry of Agriculture and Fisheries, Department of Agriculture, Scotland, and the Development Commission. It is gratifying to report that progress is being made in the recognition that the geological substratum, defined as ' parent material,' plays an important role in the development of the characteristics of the soil and is in fact the most reliable basis on which to found a system of soil classification.

The officers principally concerned in these investigations are Dr. Bernard Smith and Mr. H. G. Dines in England and Dr. M. Macgregor and Dr. J. B. Simpson in Scotland.

Mr. Dines attended a meeting of the Soils Correlation Committee in connexion with the British Association meeting at Leicester in September. The draft report of the Committee on Scottish Soils, examined during a tour in Scotland in 1932, was submitted and discussed. The report follows the lines of the previous report on English and Welsh soils. Parent material was again found to afford a suitable basis for classification and many of the English and Welsh soil types were proved to occur also in Scotland. Over 80 soil profiles were examined and the following groups were recognized according to parent material :

1. Schists
2. Grey and black shales
3. Massive limestones
4. Coarse yellow sands
5. Pebbly red sands
6. Red sands
7. Red marls
8. Acid igneous rocks
9. Basic igneous rocks
10. Serpentine
11. Brickearth
12. Peat, moor and fen
13. Silt clays
14. Drifts of varied composition

Of these, 1 to 7, also 11 and 12, are already included in the list of English and Welsh soil types (*Summary of Progress* for 1931, Part 1, *Mem. Geol. Surv.*, 1932, p. 25). The group ' igneous rocks ' is subdivided into acid and basic (8 and 9), and additional parent materials are recognized in serpentine (10), silt clays (13) and varied drifts (14). The last-named group may in future be further subdivided.

Dr. Smith and Mr. Dines have collaborated with Mr. W. Morley Davies, of the Harper Adams Agricultural College, in preparing system of colouring for soil maps, but there are difficulties in adapting the geological colours used on the Geological Survey's maps for this purpose, and the scheme is at present not finally adjusted.

In collaboration with Mr. A. W. Ling, Agricultural Officer for the Bristol District, Mr. H. G. Dines of the Geological Survey visited the Bromham area, near Chippenham, where a soil survey has been made to determine the suitability of the neighbourhood for the market-gardening industry. A special study was made of the relations of the various soil types to the underlying rock formations and it was found that essentially similar soils in that district rested on rocks of varied geological ages. It seems clear that though the parent geological formation is of great importance in determining soil characteristics it is by no means the only factor in the classification.

Forestry

The Forest Products Research Laboratory is investigating the properties of timber grown on different soils. This involves in some cases a knowledge not only of the immediate soil but also of the outcrops of various kinds of rock in the region. Especially where new areas are to be planted it is important to ascertain what varieties of trees are most likely to flourish under the geological conditions of the area. Samples of soils have been reported on by the field geologists and information has been given as requested. It is important also in many cases to know the probable thickness of the drift deposits and their approximate boundaries. In connexion with this research selected trees are being felled to prove the value of the timber grown on the different types of soil and subsoil.

Shafts, Sinkings and Borings for Minerals

England and Wales.—The boring for oil referred to in last year's Report is still in progress; the cores have been examined at frequent intervals and the record is up-to-date.

Notifications under the Mining Industry Act received during the year include shaft sinkings in the Forest of Dean and Lancashire, a prospecting drift at Tamworth, and borings for coal at Chislet Colliery, Kent, Coombs Wood Colliery, Worcestershire, and Park Collieries, Garswood, Lancashire, as well as a number of bores for gypsum.

In the new shaft in the Forest of Dean forms of *Anthracomya* cf. *tenuis* accompanied by *A.* cf. *phillipsi* have been found for the first time from this Coalfield.

At Chislet Colliery, Kent, a large series of Carbonicolas, Anthracomyas and Naiadites have been collected from between depths of approximately 1680 ft. and 1710 ft. below surface. These indicate a position apparently low in the *A.modiolaris* zone, and it

is probable that part of the Kent Coal Measures assigned to *A. pulchra* zone in the classification recently given[1] may belong to this lower zone.

The Coombs Wood Boring, commencing in the Halesowen Sandstone, has penetrated attenuated Etruria Marls and Middle Coal Measures and entered Wenlock Shale at a depth of 435 ft.

A well at Cottenham Waterworks (Cambridgeshire), twenty feet in diameter, has penetrated the lowest 20 ft. of the Gault and the top of the underlying Lower Greensand. This well has yielded an interesting series of fossils, some of which are uncommon.

Some of the Yorkshire borings for water in the Millstone Grit Series penetrated bands with marine fossils useful for correlation.

Besides the notified cases, about 42 bores or wells for water-supply have been examined in the field, chiefly by members of the field staffs.

Members of the field staffs have also answered a large number of enquiries on water supply from all parts of England and Wales, and have classified and prepared for the County files many journals received from boring firms and well sinkers, or through the Ministry of Health.

In the new Museum special accommodation has been allotted to the records of shafts and borings and to the specimens of interest collected during examination of the rocks penetrated.

SCOTLAND.—In accordance with the provisions of Section 23 of the Mining Industry Act (1926) 36 notifications of borings, mines and shafts were received in the Scottish office during the year. In several instances notifications included two or more bores. The examination of borings, mines and shafts has been mostly made by Mr. W. Manson, but in some instances bores have also been visited by officers concerned in mapping areas where boring operations were in progress. Copies of the journals have been obtained and checked, and specimens of fossils and rocks have been secured for inclusion in the collections of the Survey. The preparation of the records in graphic form has been kept up-to-date and the sites of all bores, mines and shafts have been carefully recorded on the six-inch working maps. A considerable number of enquiries has been dealt with and much assistance has also been given to mining engineers regarding the interpretation of sections of strata proved by borings, or exposed in exploratory mines.

Among the interesting information that has been acquired from bores, reference may be made to a recent boring put down near the farmhouse of Skeddoway, 2 miles west of Thornton, Fife. The site of the bore lay near the axis of the Burntisland Anticline, a structural feature which passes from the coast at Burntisland in a N.N.E. direction towards Markinch. The comparatively thin

1 Stubblefield, C.J., 'Notes on the Fauna of the Coal Measures of Kent', 'Summary of Progress for 1932', Part ii. (*Mem. Geol. Surv.*), 1933, pp. 71-77, and H. G. Dines, 'The Sequence and Structure of the Kent Coalfield,' *op. cit.*, fig. 7, p.28.

development of the Carboniferous strata along the anticlinal ridge has been known for some time, and this is reflected in the marine horizons that were encountered in the boring at Skeddoway. The highest marine horizon indicated in the bore was the Lyoncross Limestone. It was represented by a few thin beds of blaes or shales associated with three ribs of clayband ironstone. No organic remains were found in these strata. The important horizon of the Index Limestone was represented by some 2½ fathoms of shales containing small balls of ironstone and a meagre fauna of marine mollusca including *Edmondia* sp., *Limatulina* sp., *Myalina flemingi* (M'Coy), *Streblopteria ornata* (R. Eth. jun.), *Bucaniopsis striatus* (Flem.), *Euphemus urei* (Flem.) and *Zygopleura* sp. The next marine band was found in the Black Metals near the middle of the Limestone Coal Group. The fossiliferous layer, which occurred in the lower part of 3 fms. of dark sandy shales, contained the following fossils:— *Serpulites carbonarius* M'Coy, *Lingula squamiformis* Phill., *Productus* (fragments), *Pinna mutica* M'Coy, *Sanguinolites variabilis* M'Coy and *Naticopsis*? The Johnstone Shell-bed, which is very well developed in the neighbouring area of Central Fife, was absent from its position between the Dunfermline Splint and Sulphur Coals, the strata between the two seams of coal being mainly composed of sand-stone. The Upper Kinniny Limestone was represented only by two thin ribs of impure sandy limestone in some 2 fms. of shales; the latter yielded a fairly good assemblage of marine fossils.

In the district of Bandrum, north-west of Dunfermline, Fifeshire, a considerable number of borings has been put down to prove the Dunfermline group of coal seams. A seam known as the Two Foot Coal is one of the thinner members of this group and occupies a position varying from 3 to 6 fms. below the Dunfermline Five Foot Coal. The borings in the area have demonstrated the remarkable persistence of the shell-bed that occurs in the series of beds of shale or blaes that overlie the Two Foot seam. The shells, complete and broken specimens of *Lingula squamiformis* Phill., are usually found packed together in great abundance in a band of tough shale 4 to 8 in. in thickness, and varying in position from 2 to 6 ft. above the coal. The regularity of the occurrence of this shell-bed throughout the district has rendered the horizon of great service in the correlation of bores where faulting has broken the succession. Another band containing shells is occasionally present some 2 ft. above the *Lingula* shell-bed. The fossils found at this position, however, are estuarine lamellibranchs and may be referred to *Naiadites obesa* (R. Eth. jun.).

Valuable geological data have also been obtained from borings in the Coal Measures of Ayrshire, the Millstone Grit and Limestone Coal Group of the Central Coalfield, and from other borings in the Fife Coalfield.

Building Stones Research

The Geological Survey continues its joint work with the Building Research Station on the geology, petrology and characteristics of British building stones.

Many requests have been received for the determination of the stones used for various British churches, monuments and other structures and have been dealt with by the Petrographer.

Mr. F. H. Edmunds has visited the quarries of Inferior Oolite at Ketton and has furnished a brief report. The rock is obtained from the upper part of the Lincolnshire Limestone. Of about eighteen feet worked in the quarry only about one-third is used as a building stone. Many varieties of rock are recognized in the quarry.

Oolitic freestone is a homogenous oolite without calcite in the interstices between the oolitic grains. The colour varies from almost white, through cream and pink to red, but two general colour grades are recognized, cream and pink, the latter being from six to ten times as abundant as the former. *Flesh* is rotten freestone which is found in contact with the clays of the Upper Estuarine Series. *Bastard Freestone* is oolitic freestone with crystalline calcite between the oolitic grains and is rejected. *Rubbly Rag* is a nodular shelly limestone. *Panshon Rag* is a well jointed, compact, shelly limestone, blue when fresh but weathering brown. *Crash* is a rotten, ferruginous, coarse-grained oolite, generally of a red-brown colour.

Fuel Research

On all the district committees of the Fuel Research Division which advise on the investigation of local fuels there is a representative of the Geological Survey who has special knowledge of the district. His duties are to furnish geological information relating to the various researches in hand and to secure effective collaboration with the fuel experts, chemists and others who conduct the work. The Survey officers in question are :—

Scotland	Dr. Murray Macgregor
Northumberland and Durham	Mr. R. G. Carruthers
Yorkshire	Mr. C. E. N. Bromehead
Nottinghamshire	Mr. C. E. N. Bromehead
Lancashire	Dr. W. B. Wright
North Staffordshire	Dr. B. Smith
Forest of Dean	Mr. T. Eastwood
South Wales	Mr. E. E. L. Dixon.

Water Pollution Research

A fund has been provided by the Mersey Docks and Harbour Board along with certain kindred bodies, for the investigation of the effects of sewage effluent on the accumulation of deposits in the Mersey estuary. This research is being carried out by the Water

Pollution Research Board of the Department of Scientific and Industrial Research. It involves a number of difficult questions regarding the nature, transport and deposit of sediment both in the channel and in the estuary. Dr. W. B. Wright, who is in charge of Geological Survey work in Lancashire, serves as geologist to this enquiry, and has attended the meetings of the Committee in London in addition to making an examination of the general conditions in the Mersey estuary.

Conferences

At the British Association meeting in Leicester in September the Geological Survey made a special exhibit of its maps, memoirs, and photographs. Dr. Hallimond also demonstrated the methods of geophysical surveying in the field.

The Director attended the 14th meeting of the International Geological Congress, which was held in Washington in September, as one of the British representatives.

A special display of recent publications of the Geological Survey was exhibited at the annual Conversazione of the Geologists' Association in November.

Mr. F. H. Edmunds delivered his Presidential Address to the Geological Section of the South-Eastern Union of Scientific Societies at Norwich.

Sir John Flett has served as President of the Mineralogical Society and is also serving as President of the Edinburgh Geological Society during its Centennial Session 1933, 1934.

Mr. H. G. Dines has been awarded the Bolitho medal by the Royal Geological Society of Cornwall.

Mr. C. E. N. Bromehead is serving as President of the Hull Geological Society.

Collaboration

The Geological Survey gratefully acknowledges the assistance received during the year from many British geologists and palaeontologists in the description of fossils collected during the course of Geological Survey work. The following are the principal contributors :

Sir Arthur Smith Woodward, LL.D., F.R.S., has furnished notes on ' Some Fish Remains from the Missenden Boring ' published in the *Summary of Progress* for 1932, Part II, 1933, pp. 140-142.

Professor D. M. S. Watson, F.R.S., University College, London, has written a chapter on the Fossil Fishes of the Middle Old Red Sandstone for the Memoir on ' The Geology of the Orkneys ' (*in the press*). He has also contributed a note on Fossil Fishes from Shetland to this volume (p. 74).

Professor W. H. Lang, F.R.S., Manchester University, has written an account of Fossil Plants from the Old Red Sandstone of Orkney for the Memoir on ' The Geology of the Orkneys ' (*in the press*).

Professor H. P. Lewis, M.A., F.G.S., has contributed to the *Summary of Progress* for 1933, Part II, a paper on ' The Occurrence of Fossiliferous Pebbles of Salopian Age in the Peel Sandstones of the Isle of Man ' (*in the press*).

Mr. S. H. Straw, M.Sc., F.G.S., of Manchester University, has written a report on ' The Fauna of the Palaeozoic Rocks of the Missenden Boring ' which is published in the *Summary of Progress* for 1932, Part II, pp. 112-140.

Dr. Gertrude Elles of the Sedgwick Museum, Cambridge, has written an important paper on ' The Lower Ordovician Graptolite Faunas with special reference to the Skiddaw Slates,' published in the *Summary of Progress* for 1932, Part II, pp. 94-111.

Professor A. E. Trueman, of Bristol University, furnishes ' Notes on the Fossils from the Lower Coal measures in Messrs. Jarmain's Boring, Kirkheaton ' to the *Summary of Progress* for 1933, Part II (*in the press*).

Dr. J. Wilfrid Jackson, D.Sc., F.R.S., of Manchester University, has contributed an account of ' The Marine Fossils in Messrs. Jarmain's Boring, Kirkheaton ' (*op.sup.cit.*)

Mr. L. Richardson has sent in the manuscript of a Memoir on ' The Wells and Springs of Herefordshire.'

Mr. E. S. Cobbold, with Dr. R. W. Pocock (of the Geological Survey) has prepared a Memoir on ' The Cambrian Rocks of the Rushton District ' to be published in the *Transactions of the Royal Society of London* (*in the press*).

We have also to acknowledge assistance received from Dr. L. F. Spath (in the determination of ammonites), Professor H. L. Hawkins (echinodermata), Dr. Stanley Smith (corals) and Professor Walton, of Glasgow University (fossil plants).

The collections of the Geological Survey have been freely accessible to investigators in geology and palaeontology, and a note on the principal specimens described and figured in scientific publications during the year will be found in the Palaeontologist's report (p. 77).

Palaeontology

England and Wales.—In consequence of the increasing attention paid to the preparation of exhibits for the new Museum, it was necessary to curtail the programme of fossil-collecting. The specimens added to the collections during the year numbered 3,000, of which 473 were acquired by presentation. The number of fossils registered within that period was 9,500. Although the additions obtained by gift include no large single collection, there are many choice and useful specimens among them. Mr. E. W. J. Moore

sent numerous goniatites which enrich the collections representative of particular horizons in the Millstone Grit and Carboniferous limestone. All gifts of fossils received during the year are noted in the List of Donations on pp. 37-40.

All members of the staff of the Palaeontological Department have continued the work of preparing exhibits for the new Museum, particularly those designed to illustrate the regional geology of England and Wales. This involves the selection and naming of specimens, their suitable arrangement for display in the exhibition cases, the preparation of labels, and the technical work connected with the cleaning and the mounting of specimens to the best advantage. Much time has been devoted to this work. A certain amount of special field-collecting required in this connexion has also been carried out.

Dr. Kitchin did further work in selecting, arranging and labelling specimens for the Weald, and London and Thames regional exhibits. Much of his time was occupied in dealing with matters of detail concerning exhibits for the new Museum, and, as usual, he has done a considerable amount of editorial work.

In the course of his work on material from areas dealt with in Sheet Memoirs, Mr. C. P. Chatwin revised a series of fossils from the Wealden and Lower Greensand collected in the Redhill-Earlswood railway-cutting in 1899. He also wrote a chapter on the palaeontology of the Cretaceous formations for inclusion in the Reigate Memoir. In addition he named a series of fossils from the Gault and Oxford Clay collected within the area of the Bridport Sheet.

In connexion with the visit of the South-Eastern Union of Scientific Societies to the Museum on May 20th, Mr. Chatwin prepared a special exhibit illustrating the stratigraphy and palaeontology of the Crag deposits of East Anglia. He has since enlarged the series of Pliocene fossils selected for the exhibited stratigraphical collection in the new Museum. He devoted much time to the preparation of the exhibits illustrating the regional geology of the Hampshire Basin, selecting all the material necessary for display and making good progress with the preparation of labels. He also assembled the complete series of rock-specimens necessary for the cases illustrating East Anglian geology, and named Cretaceous and Pleistocene fossils and prepared corresponding labels for the Weald, London and Thames, and other exhibits. Mr. Chatwin continued the work of collating specimens in the Geological Society's Collection before their registration by Miss Odell, and some of his time was occupied by editorial duties.

Dr. C. J. Stubblefield named Silurian fossils collected from a boring in Sheet 199, and Carboniferous fossils from borings in Sheets 37 (Gosforth) and 87 (Barnsley). He also named a series of Carboniferous specimens from collections made in Sheet 75 (Preston), and Permian fossils from Sheets 84 (Wigan) and 97

(Runcorn). He also made progress in determining the large set of Carboniferous fossils collected during the survey of Sheet 23 (Cockermouth) and has prepared synoptic lists for use in the forthcoming memoir.

Dr. Stubblefield made substantial contributions to the new exhibits of regional geology, selecting, naming, and labelling Cambrian fossils for one exhibit, Ordovician for another, Silurian for four districts, Carboniferous for two, and Pleistocene for one. He also spent some time in doing editorial work.

The investigation of certain groups of fossils, required in connexion with current Survey work, has been undertaken, in whole or in part, by specialists who are not members of the staff.

Miss M. E. Odell has been wholly engaged in carrying on registration work. She has made progress in overtaking arrears, particularly in the registration of the Geological Society's Collection.

Numerous enquiries were dealt with during the year, and much assistance was rendered to research-workers who utilized specimens in the Museum, in connexion with the preparation of papers or monographs for publication.

The specimens sent out on loan during the year numbered about 1,000.

SCOTLAND.—Nearly 2,000 specimens were collected during the year and added to the Survey reference-collections. The majority of the fossils were obtained from Carboniferous rocks, either in areas underlying revision or from borings in Ayrshire, Fife, Midlothian, Northumberland and Durham. Of considerable interest are the small collections of fish-remains from the Old Red Sandstone of the Sandness district in the Shetland Islands, and the Jurassic and Cretaceous fossils from certain localities in Mull and Morven. As formerly, the bulk of the material was collected by Messrs. Tait, Manson, Eckford and Fisher, and with the exception of the fish-remains, which have been sent to Professor D. M. S. Watson, F.R.S., identification of the specimens has been carried out by Dr. J. Pringle.

The registration of the specimens in the John Smith Collection has now been completed by Mr. E. M. Anderson. Over 20,300 fossils have been numbered and the entries have been made by him in the departmental registers. He has also prepared a card-index of localities. A large number of types and figured specimens from the same collection have been mounted on tablets by Mr. Fisher, and are now ready to be placed in the exhibited collection of the Geological Survey in the Royal Scottish Museum.

Numerous specimens have been sent out during the year to approved borrowers engaged in research work.

Palaeobotany

During 1933 fossil plants have been identified from thirteen one-inch Sheets in England and from four one-inch Sheets in Scotland.

Additions to the palaeobotanical collections include a large number of fossil plants collected by the Palaeobotanist from the Kent Coalfield, while three microscope sections of *Cheirostrobus pettycurensis* and two of *Lepidodendron wünschianum* have been purchased from Mr. W. Hemingway, of Derby. Among the noteworthy presentations of plant specimens may be mentioned: (1) a large 'cellulose pull' of *Lepidodendron wünschianum* presented by Professor A. C. Seward, F.R.S., (2) an important suite of 41 microscope preparations of the fructifications of ferns and Pteridosperms by Professor T. G. Halle, Stockholm, (3) plant incrustations from above the Better Bed Coal of Yorkshire by Mr. James Walton of Brighouse (including a number of Stigmarian rootlets showing bifurcation) and (4) plants from the Lower Division of the Coal Measures of Bristol, by Mr. L. G. G. Warne, of Bristol University.

Field work has consisted in two visits to the Kent Coalfield, during which collections were made at each pit.

Specimens have been loaned to Professor W. H. Lang, F.R.S., Dr. Margaret Benson, Professor H. S. Holden, Dr. Emily Dix, Dr. R. G. Absalom and others.

Museum work has claimed the bulk of the Palaeobotanist's time. The chief item consisted in the preparation of the Regional Exhibit illustrating the geology of the Bristol-Gloucester area. In this work assistance has been received from Dr. Welch. Further progress has been made with the Coal Exhibit, while plant specimens have been selected for other exhibits.

During the year 63 photographs of fossil plants were taken.

Petrography

England and Wales.—The work of the Petrological Department has been exceptionally heavy during the past year, for, in addition to normal routine duties connected with districts being surveyed and enquiries from the general public, much time has had to be spent on the planning and preparation of exhibits for the new museum, the selection of material, and the curation of the collections.

The registration of museum rock-specimens has been continued by Miss Guppy and the number to date stands at 10,364. Of the older collections, the history of each specimen has been recorded as far as can be ascertained and gaps have been filled by recent collection.

The preparation of a comprehensive exhibit of the rock-forming minerals, which was interrupted last year by other duties, has been resumed by the Petrographer and Miss Guppy, and is nearing

completion. It is hoped that this when placed on exhibition will form a useful introduction to the study of microscopic petrography.

Mr. T. G. Jones has visited various districts to collect rock-specimens needed to supplement the existing collections for exhibition in the new museum. From the districts of Worcestershire, Warwickshire, the Forest of Dean, the Avon Gorge, the Mendip Hills, etc., 77 specimens were collected; while 88 were obtained from the Jurassic formations of the Oxford and Swindon districts. Mr. Jones has also helped in the preparation of specimens prior to their registration and in the drawing of diagrams and maps for exhibition purposes. Small collections of hand-specimens of typical rocks have also been made and deposited by members of the field-staff.

Mr. Andrews and Mr. Hepple have prepared more than the average annual number of thin sections during the past year, and in addition have done a good deal of necessary work in connexion with the curation and registration of the sliced rock collections. Mr. Hepple also assisted the Petrographer in the preparation of a scale model of Stonehenge, in the original materials, to be placed on exhibition in the new museum.

The number of sliced rock-specimens and corresponding sections registered in the collections and housed in the Petrographical Department in London, is as follows:—

English and Welsh	16,921
Scottish	30,376
Irish	841
Foreign	3,694
Total	51,832

This represents an aggregate increase during the past year of 2,152 in the registered sliced specimens. Of these 918 were made by Messrs. Andrews and Hepple in the London Office, 228 were registered to be made in Scotland, and 1,008 were acquired by purchase. The last item includes interesting collections of foreign rocks and corresponding thin sections from Sardinia, Switzerland, Italy and Germany; and a valuable collection of rocks and sections from British localities described by Prof. S. H. Reynolds.

During the year 516 rock specimens and 1,011 sections were dispatched to various Survey officers in Scotland for study in connexion with the progress of mapping and the preparation of memoirs.

SCOTLAND.—In Scotland 1,124 rock specimens were collected in the counties of Dumfries, Argyll, Inverness and Shetland, and 228 microscopic sections were prepared.

Much petrographical work was done by Dr. Phemister on dyke rocks from Sheet 17 (Jedburgh), by Mr. A. G. MacGregor on Highland rocks and the igneous rocks of Ayrshire and Dumfriesshire

and by the Director on igneous rocks from the Orkneys. The petrography of the Shetlands is being done in Edinburgh by the Scottish staff.

Photographic Work

England and Wales.—The photographic work during the past year has been carried out mainly for the purpose of exhibits in the new museum. With this end in view a great number of enlargements have been made from Survey negatives by Mr. Rhodes and Mr. Radley, while Mr. Rhodes has visited the districts of South Wales, the Welsh Borders, Bristol and Gloucester, Lincolnshire, and Westmorland to take photographs of special geological interest. These number 129, while an additional 59 geological views were taken in Inverness and Argyll by Mr. Strachan.

The indoor-work carried out by Mr. Rhodes and Mr. Radley has been the preparation of 303 sepia-toned enlargements for exhibition in the new museum, also 45 others of which 35 were to fulfil outside orders for the public.

Lantern-slides have been made to the number of 612, of which 477 were outside orders.

Contact-prints to the number of 941 have been prepared from Survey negatives. Of these 573 were for incorporation in the Survey albums, 22 for reproduction in Survey publications, 19 for museum exhibits, and 96 extra prints for miscellaneous purposes.

The number of negatives now registered is as follows:—

English Photographs	6,314
Photomicrographs	2,187
Miscellaneous Photographs	2,713
Total	11,214

Scotland.—The number of photographs taken during the year is 58. The registered negatives in the Scottish Collection are

Whole plate Scottish photographs ...	933
Half plate Scottish photographs ...	3,482
Photomicrographs	38
Total	4,453

Chemistry

The number of analyses registered in this Department's records at the end of 1933 is as follows:—

English	358
Scottish	586
Irish	2
Welsh	55
Others	52
	1,053

Of these, nineteen have been completed during the year and seven are still in progress. Twenty-nine qualitative analyses have been carried out for Survey officers and numerous enquiries have been dealt with. Work in connexion with the fittings and apparatus required in the laboratory of the new Museum has been continued.

Museum of Practical Geology

Apart from the routine work of cataloguing, registration and current enquiries the Museum Officers, in collaboration with Mr. V. A. Eyles, Dr. W. Q. Kennedy, and other Survey Officers, have been employed entirely on the preparation of exhibits for the new Museum. In this connexion visits were made to the North-West Highlands, Portland Isle, Alum Bay, and Corby, and dioramas illustrating the geology of these districts have been put in hand, and in some cases carried to completion. The work of selecting and labelling material for exhibition has progressed steadily and draughtsmen have been employed throughout the year on the preparation of large-scale maps and diagrams to illustrate aspects of general and economic geology.

The organising of the exhibits was to some extent delayed by the occupation of the new building by the World Economic Conference but since October, when that occupation was terminated, preparations for the transference of the staff and the collections have been actively pursued. A large proportion of the furniture for the new Museum has now been delivered and it will soon be possible to assemble exhibits *in situ*.

The Library has been used to an increasing extent by students and research workers and has shown steady expansion throughout the year. Preparations for its transfer to South Kensington are now well advanced.

List of Donations during the Year 1933

Ainsley, J. B. G., Esq.—Series of Lamellibranchs from the Corallian (Sandsfoot Grits) of Sandsfoot Castle, near Weymouth; also a series of rock specimens and fossils from the Jurassic and Cretaceous beds in the neighbourhood of Weymouth, Dorset.

Barnard, G. C., Esq., F.G.S.—Descloizite with calcite, from Kipushi, Katanga.

Baverstock, H. J. Esq.—Specimen of Bargate Stone.

Beck, H. C., Esq.—Laterite beads from Ashanti.

Blake Whelan, C., Esq.—Four flakes from excavations in Rathlin Island, Antrim, Ireland.

Brammall, A., Esq., D.Sc., Ph.D., D.I.C., Assoc.Inst.M.M.—Large specimen of granite-picrite hybrid from Malvern, Worcestershire.

Cafferata and Co. (*per* R. L. Sherlock, Esq., D.Sc., F.G.S., A.R.C.S.).—Large nodule of gypsum from Hawton Quarry, Newark-on-Trent, Nottinghamshire.

Chambre Syndicale des Mines de Fer de France.—Suite of iron ore specimens from Marbache and other districts.

Clegg, D. T., Esq.—Shale specimen bearing plant remains from Coal Measures at Messrs. Stanley Bros.' Brick and Terra Cotta Works, Nuneaton, Warwickshire.

Cobbold, E. S., Esq., D.Sc., F.G.S.—Part of a Trilobite, *Callavia callavei* (Lapworth), from the Lower Cambrian limestone of Dryton Brook, Shropshire.

Colonna, E., Esq.—A collection of clay-stone concretions (' Fairy-stone ') from bed of Connecticut River, Pleasant Valley, Mass., U.S.A.

Cooke, J. and Sons.—Samples of chalk and lime from Dorking Greystone Limeworks, Dorking, Surrey.

Cox, Prof. A. H., D.Sc., Ph.D.—Sun Vein Coal (Millstone Grit Series) from 1 mile N.E. of Taff's Well, Glamorgan.

Dewey, H., Esq., F.G.S.—Flint scraper from Cissbury, near Worthing; also bone breccia and casts of implements from Kent's Cavern, Torquay.

Dix, Miss E., M.Sc., F.G.S., and S. W. Hester, Esq.—Series of fossils from the Millstone Grit of Mawstone Mine, near Youlgreave, Derbyshire.

Engelbach, R., Esq. (Curator, Egyptian Museum, Cairo).—Diorite from a rediscovered site in the Nubian Desert.

Fearnsides, Prof. W. G., M.A., F.R.S., F.G.S.—One section of pisolitic pyrites from Tremadoc, Portmadoc, Carnarvonshire.

Fearnsides, Prof. W. G., M.A., F.R.S., F.G.S., and W. H. Wilcockson, Esq., M.A., F.G.S.—Two specimens of Goniatites from the Millstone Grit of the Oxspring Borehole, near Penistone, Yorkshire.

Golden Valley Ochre and Oxide Co., Ltd.—Crude and powdered ochres and fullers earth from Wick, near Bristol.

Grant, W. J., Esq., M.Inst.M.E., M.Inst.C.E.—Nodule of flint enclosing a cast of *Micraster praecursor* Rowe, from Gravel about half a mile east of Rainham Station, Essex.

Grays Chalk Quarries Co., Ltd.—Whiting exhibit and three jars of substances used in the manufacture of Portland Cement.

Gurney, Mrs. S. M. (*per* R. W. Pocock, Esq., D.Sc., F.G.S.).—A collection of Mammalian remains from the high level gravel of the River Rea, near Kidderminster, Worcestershire.

Halle, Prof. T. G. (Naturhistoriska Riksmuseum, Stockholm, Sweden).—Forty-one microscopic preparations of the fructifications of ferns and Pteridosperms, from the Coal Measures.

Hester, S. W., Esq.—Series of Goniatites from the Millstone Grit of various localities, chiefly in Derbyshire and North Staffordshire.

Hine, R., Esq. (*per* F. B. A. Welch, Esq., B.Sc., Ph.D., F.G.S.).—Specimen of *Astarte excavata* J. Sowerby, from the Inferior Oolite of Waddon Hill Quarry, Stoke Knap, Dorset.

Hobley, C. W., Esq., C.M.G., A.M.Inst.C.E., F.G.S.—Metacarpal of *Bos sp.*, from the Pleistocene (Lower Gravel) at Rickson's Pit, Swanscombe, Kent; also two specimens of *Connulus sp.*, from the Middle Chalk (Cuvieri Zone) of Beer, Devon.

Hopkins, W., Esq., M.Sc., Ph.D., F.G.S.—Series of specimens from the Coal Measures of Northumberland and Durham.

Howell, W. C., Esq.—Specimen of milky quartz on chalcopyrite and blende, the edges of the quartz crystals being outlined with ribs; probably from Cornwall.

Howes Smith, Miss M., M.A.—A choice specimen of a spine of *Asteracanthus sp.*, from the Purbeck Beds of Swanage, Dorset.

Jack, G. H., Esq., M.Inst.C.E., F.R.I.B.A., F.S.A., F.G.S.—Seven specimens of *Pteraspis sp.*, from the Lower Old Red Sandstone in quarry, near school, at Wayne Herbert, Newton, West Herefordshire.

Jackson, H. S., Esq.—Labradorite from Madagascar.

Johnson, T., Esq., D.Sc., M.R.I.A., F.L.S., F.R.S.E.—Leaf impressions and a fruit of species of *Dewalquea*, from the Tertiary beds in a boring at Washing Bay, Co. Tyrone, Ireland.

Johnston, Miss M. S., F.G.S., F.R.G.S., F.Z.S.—Specimen of *Homoeosolen gamblei* Gregory, from the Chalk of Banstead, Surrey; and *Spinopora dixoni* Lonsdale, from the Chalk of Rottingdean, Sussex.

KING, W. WICKHAM, ESQ., M.Sc., F.G.S.—Series of marine shells, and specimens of *Anglaspis macculloughi* (A. S. Woodward) and *Didymaspis grindrodi* Lankester, from the Downtonian Series of Worcestershire and Shropshire.

LANG, PROF. W. H., D.Sc., F.R.S.—Specimen and counterpart of *Hemicyclaspis sp.*, from the Downtonian Series of Freshwater East, Pembrokeshire.

LANGLEY, S., ESQ., the late.—Four specimens from Croft Quarry, Leicestershire; also five specimens from Groby, Brazil Wood, etc., Leicestershire.

LAWSON, P. N., ESQ.—A series of specimens from the Lower Greensand of Haslemere, Surrey; and plants from the Coal Measures of Camerton, Somerset.

LEE, R. J., ESQ.—Aragonite encrustation from a domestic boiler after some years' use.

LEWIS, S., ESQ.—Specimen of *Lepidostrobus variabilis* (L. and H.) from the Yorkian Series of Ashton's Green Colliery, St. Helens, Lancashire.

LEWIS, PROF. H. P., M.A., F.G.S.—Eleven microscopic slides of Corals from the Peel Sandstone of the Isle of Man.

LYLE, A. M., ESQ.—Hazel nuts in peaty clay (at a depth of 24 ft.) from excavation for docks at the sugar refinery, Plaistow Wharf, Victoria Docks, London.

MACGREGOR, MALCOLM, ESQ., M.Sc., PH.D.—Xenolithic Granite from Dalbeattie, Scotland.

MARSDEN, J. G., ESQ. (*per* H. Dewey, Esq., F.G.S.).—A series of shells from the Quaternary and Reading Beds, north of Hitcham, Buckinghamshire; and incisor tooth and part of an antler of Deer from the Quaternary, Peat Bed, at Dewe's Pit, South Harefield, Middlesex.

MOORE, E. W. J., ESQ., B.Sc., A.I.C.—A series of Goniatites from the Millstone Grit of Staffordshire, Lancashire and Yorkshire; and from the Carboniferous Limestone of Yorkshire and the Isle of Man.

MOUNT LYELL MINING AND RAILWAY CO., LTD.—Copper Ore and associated rocks from Mt. Lyell.

NEW, W. S., ESQ.—White cassiterite with pyrite, from Chocaya la vieja, District of Chocaya, S. Bolivia.

NEW JERSEY ZINC CORPORATION.—A series of zinc ores and associated rocks from four localities in the United States.

NORTH DEVON ATHENAEUM, BARNSTAPLE, MUSEUM COMMITTEE OF (*per* H. Dewey, Esq., F.G.S., and F.B.A. Welch, Esq., B.Sc., PH.D., F.G.S.).—Specimen containing impressions of *Spirifer sp.*, from the Lynton Beds, Lower Devonian, in the Valley of Rocks, Lynton, Devon.

PACIFIC COAST BORAX CO.—Large crystals of colemanite and other borax minerals from California.

PARKINSON, J., ESQ., M.A., Sc.D.—Twenty micro-sections from Tintagel, Cornwall.

POCOCK, R. W., ESQ., D.Sc., F.G.S.—Two specimens of *Stricklandinia lirata* (J. de C. Sowerby) and a Favositoid coral, from the Upper Llandovery of Herefordshire and Staffordshire.

PULFREY, W., ESQ., M.Sc., PH.D.—Specimens and slides of North Wales iron ores.

RAISTRICK, A., ESQ., M.Sc., PH.D., and T. S. WESTELL, ESQ. (*per* S. E. Hollingworth, Esq., M.A., D.Sc.).—Flint chips and implements from Mesolithic sites at Lyne Hill, near Newbiggin-on-Sea.

REID, DR. W. E.—Native copper, corundum and diamond gravel from Namaqualand.

REYNOLDS, PROF. S. H., M.A., Sc.D., F.G.S.—A series of Silurian fossils from the Clogher Head district, Co. Kerry, Ireland.

RHODES, J., ESQ.—A choice specimen of *Syringopora sp.*, and two specimens of *Lithostrotion sp.*, from the Carboniferous Limestone of Ravenstonedale, Westmorland.

Richardson, L., Esq., F.R.S.E., F.G.S.—A series of Ammonites from the Fuller's Earth of Somerset and Gloucestershire.

Ries, Prof. H. (Cornell University, Ithaca, N.Y., U.S.A.).—American ores of iron, mercury, manganese, etc.

Sedgwick Museum, Cambridge (*per* A. G. Brighton, Esq., M.A., F.G.S.).—Three specimens of Middle Cambrian fossils from North Wales.

Shepherd, W. B., Esq., F.G.S.—Specimens of wood bored by *Turnus sp.*, and impression (cast) of an Ammonite from the Folkestone Beds of Coxbridge Pit, near Farnham Church, Surrey.

Simcox, Miss.—Two specimens of zeolites from Lonauli, Poona district, India.

Simpson, H. H., Esq., B.Sc.—Specimen of *Gastrioceras cancellatum* Bisat, var. *crencellatum* Bisat, from the Millstone Grit of Minera Hill, near Wrexham, Denbighshire.

Somers, W., Esq. (*per* R. L. Sherlock, Esq., D.Sc., A.R.C.Sc., F.G.S.).—Samples of peat from Flitwick, Bedfordshire.

Stewarts and Lloyds, Ltd., Messrs.—Ironstone and associated rocks from the Corby district, Northamptonshire.

Teague, G. W., Esq.—Two specimens of enhydros from Uruguay.

Templeman, A., Esq.—Specimen preserved in counterpart of the Arachnid *Anthracosiro* cf. *woodwardi* Pocock, from the Coal Measures (roof-shale of No. 5 Seam), Chislet Colliery, Kent; and a series of Goniatites from the Millstone Grit at the River Derwent, near Beeley, Derbyshire.

Turner, J. Selwyn, Esq., B.Sc., F.G.S.—Specimen of *Rhizodus hibberti*? Agassiz, from the Basement conglomerate (below S_2) of the North Pennine Carboniferous of Swindale Beck, near Hilton, Westmorland; and a series of *Anthracomya sp.*, from the Coal Measures of Argill Beck, South Stainmore, Westmorland; also Nautiloids from the Calcareous Shales above the Undeset Limestone in the River Leeth, Shap district, Westmorland.

Waihi Gold Mining Co., Ltd.—Ore and associated rocks, from Waihi Mine, New Zealand.

Wale, Messrs. R. and H.—Specimen of Ammonite, cf. *Perisphinctes variocostatus* (Buckland), and *Belemnites sp.*, from Boulder Clay at Old House Tea Room, near Eltisley Church, Cambridgeshire.

Wallis, F. S., Esq., D.Sc., Ph.D., F.G.S.—Four specimens of fish-remains from the Old Red Sandstone of Woodhill Bay, Portishead, Somerset, including *Holoptychius nobilissimus* Agassiz, *Glyptopomus kinnairdi* Huxley, and a Rhizodont scale.

Walton, J., Esq.—Two specimens of Lamellibranchs from the Lower Coal Measures near Brighouse, Yorkshire; also three specimens of fossil plants from Coal Measures above the Better Bed, Sheepridge, Yorkshire.

Warne, L. G. G., Esq., B.Sc.—Ten specimens of fossil plants from the Coal Measures at Speedwell Pit, Bristol.

Welch, F. B. A., Esq., B.Sc., Ph.D., F.G.S.—A series of Ammonites from the Upper Lias of Dorset; and a series of Carboniferous and Jurassic fossils from the Mendip Area and North Dorset.

Whittard, W. F., Esq., B.Sc., Ph.D., A.R.C.Sc., D.I.C., F.G.S.—Four specimens from the Lower Cambrian (Lapworthella Limestone) of Chermes Dingle, Shropshire; and four specimens from the Tremadoc (Bronsil Shales, Dictyonema Zone) of Chase End Hill, Malvern Hills, Gloucestershire.

Wingfield, A. H., Esq.—Alunogen from Dolcoath Mine, Cornwall.

Tilmanstone (Kent) Collieries.—Sample briquette and coaloids, etc.

Youd, H., Esq.—Massive beryl from Mangualde, Beira, Portugal; also torbernite from Urguirica Mine, Nellas, Portugal.

John S. Flett,
Director.

II. DISTRICT REPORTS
(A)—ENGLAND AND WALES
1. SOUTHERN DISTRICT

HENRY DEWEY, District Geologist.
H. G. DINES, A.R.S.M., A.M.INST.C.E., Senior Geologist.
W. LLOYD, B.Sc.
F. H. EDMUNDS, M.A.
S. BUCHAN, B.Sc.
F. B. A. WELCH, B.Sc., PH.D. } Geologists.

DURING most of the year the staff were engaged upon indoor work in arranging exhibits of regional geology for the Museum. Messrs. Dewey and Welch have nearly completed a series of cases illustrating the geology of Cornwall, Devon and Somerset, paying due regard to the economic bearing of the rocks and minerals. Mr. Dines has prepared many cases illustrating the mode of occurrence of British ore-bodies, while Mr. Edmunds has completed an exhibit of the rocks, fossils and views of the Weald of Sussex and Kent.

The publication of six-inch scale, colour-printed geological maps of the London district having been sanctioned, the work of preparation has been carried out by Messrs. Dewey, Buchan and Welch. Eight sheets are printed off, while a number of others are engraved; about half the number likely to be published are now nearly ready. The importance of these maps to engineers has been carefully borne in mind, and for this reason details are engraved of many boreholes, and records of temporary shallow exposures for pipe-lines, railways and docks have been inserted.

Former courses of streams, partly filled in and forgotten, are a recurring source of trouble and expense in building operations, and in view of this experience great care has been exercised in determining as precisely as possible the position of these streams and their alluvial deposits, and the correct representation of them on the maps.

The demand for information with regard to artesian water, sites for buildings and general engineering activities is increasing yearly, and some 500 enquiries have been dealt with during the year by the staff of the Southern district. In addition, co-operative work between the Survey and other bodies has been continued. Mr. Dines visited Leicester, and at Bromham, near Chippenham, he, with Mr. A. W. Ling, Agricultural Adviser for the Bristol district, examined the locality from the point of view of its market-garden possibilities. He also reported upon many soils on behalf of the Forest Products Research Laboratory. Mr. Dines completed his account of the Kent Coalfield which has now been published[1] under the title of ' Sequence and Structure of the Kent Coalfield.' It has already been extensively quoted.

[1] ' Summary of Progress for 1932,' Pt. ii (*Mem. Geol. Surv.*), 1933, pp. 15-43.

Bridport Map (Sheet 327)

Jurassic Rocks.—Although only a limited time was available for field-work some important and interesting results have come from Dr. Welch's work in the Beaminster and Evershot areas. In these districts the Fuller's Earth and the Lower Forest Marble form a great thickness of clay in which it is extremely difficult to recognize any change of lithology. Dr. Welch, however, has been able by careful search to trace outcrops of the 'Brachiopod bed'[1] in the middle of the Fuller's Earth Clay, and at the base of the Forest Marble he has proved that the *Goniorhynchia boueti* Bed previously noted,[2] forms a constant horizon. There are thus two datum lines which should be of much value in elucidating structures, and as guides in the search for water by boring. By means of fossils he has also been able to assign to the Oxford Clay beds previously mapped as Forest Marble Clay. The drought dried up streams and thus rendered possible an examination of their beds, and from this circumstance Dr. Welch was able south-west of Mountover Farm to collect the following forms:—*Modiola bipartita, Goniomya V-scripta*. These beds are succeeded by clays yielding *Nucula, Pseudomonotis ovalis*, and numerous small gryphaeate oysters. Higher beds of Oxford Clay are seen north of the margin of Sheet 327, in a deep ravine near Grexy Cross, where large septarian nodules occur in association with clays packed with crushed shells of *Cosmoceras*.

Cretaceous Rocks.—In normal years a stream section in the Gault at a point ¾ mile N.E. of Rampisham could not have been examined, but Dr. Welch collected the following Lower Gault forms when there was scarcely any water in the valley:—*Turritella, Nucula pectinata, Inoceramus concentricus, Pecten (Syncyclonema) orbicularis* and *Ostrea canaliculata*.

An important change in the lithology of the Upper Greensand formation has been observed. East of a line drawn north-west from Tollerford through Wraxall to Horsey Knapp (west of Evershot) beds of chert and siliceous meal which, west of this line, separate coarse quartzose calcareous grit from the underlying *Exogyra* sandstone, disappear; while the coarse calcareous grit beds are replaced by fine grained white quartz-rock speckled with grains of glauconite.

Sevenoaks Map (Sheet 287)

Lower Cretaceous.—On his return from the Shetland Islands Mr. Buchan continued the survey of the area he had left unfinished in 1932. He mapped the bed of sandstone, noted by W. Topley farther west, across the area surveyed, and in addition dis-

[1] See Buckman, S. S., *Quart. Journ. Geol. Soc.*, vol. lxxviii, 1922, p. 381.

[2] 'Summary of Progress for 1931' Pt. i, (*Mem. Geol. Surv.*), 1932, p. 40.

covered several bands of limestone in the Weald Clay. The Atherfield Clay has been found to be about 30 to 40 ft. thick : it is of importance from the point of view of water supply, for it holds up water in the overlying Hythe Beds and throws out strong springs. This arrest of percolating water is also of importance from an engineering point of view for it leads to landslips, some on a large scale, as at Crockham Hill, where the main road is threatened.

The Hythe Beds near Limpsfield Common contain beds of sandstone, suitable for building material, at the top of the formation. ' Kentish Rag,' a sandy limestone, however, occurs only at the base of the formation in the Chartwell Estate : hitherto it has not been found west of that locality. Water from the Hythe Beds is soft about, and west of, Payne's Hill, but becomes harder at Crockham Hill, and east of it, a fact that strengthens the inference of the incoming of the Rag. The Rag thickens eastwards, and more beds of it come in among the ' hassock.'

H. DEWEY.

2. WEST MIDLANDS AND CAMBRIDGE DISTRICTS

C. H. Dinham, B.A., District Geologist.
E. E. L. Dixon, B.Sc., A.R.C.Sc.
R. L. Sherlock, D.Sc., A.R.C.Sc.
R. W. Pocock, D.Sc.
T. H. Whitehead, M.Sc., A.R.C.Sc. } Senior Geologists.
T. N. George, D.Sc., Ph.D., Geologist.

ONLY two members of this unit carried out routine mapping in the districts here considered. In the Biggleswade Sheet (204) Mr. Dixon completed his work around Royston, and began revision of the ground north of Gamlingay. Dr. Pocock in the Droitwich Sheet (182) continued field-work around Cleobury Mortimer, Bayton and Mamble. Mr. Whitehead spent a few days at Trimpley and in the Wyre Forest, but his autumn season of field work was undertaken in the neighbourhood of Preston, Lancashire. All the officers excepting Mr. Dinham and Mr. Dixon have been engaged in preparing exhibits for the new Museum. Dr. Sherlock has been thus occupied throughout the year, and Dr. George until the summer, when, after a short period in the field to round off his area, he resigned to take up a professorship at Swansea.

In this year of abnormal dryness, enquiries about water-supply have been received from individuals, public bodies, and Government Departments in greater number than usual. A perceptible increase in applications for information from persons preparing to open up sand-pits, lime-works, or brickyards seems to reflect some improvement during the year in the industrial outlook. Many journals of bores and well-sinkings have been filed and classified. Amongst other work, contributions have been made to the forthcoming map of the Coalfields of Great Britain. Mr. Dinham has also been preparing material for a revised edition of the quarter-inch index map of Norfolk, The Wash, and South Lincolnshire (Sheet 12). The results of some bores for oil-shale described by Dr. Pringle,[1] supplemented by others not yet published, entail interesting alterations to the Lower Cretaceous outcrops in west Norfolk; at the south-east end of the Lincolnshire Wolds, also, these outcrops require modification in the light of recent searches for artesian water-supplies. The Corallian clays are again being delimited as far as possible from the Oxford and Kimmeridge Clays, as was done last year for the map adjacent on the south.

Droitwich Sheet

Silurian, Downtonian and Old Red Sandstone.—Dr. Pocock has completed the mapping of the Silurian inlier at Neen Sollars. The trend of the fault that bounds the Ludlow Beds of the inlier on the south-west suggests that it is a reversed fault, due to a thrust from the north-east on to a dome of Downtonian rocks centred at

[1] Pringle, J., 'Summary of Progress for 1922' (*Mem. Geol. Surv.*), 1923, App. I, pp. 126-139

the bridge over the River Rea at Neen Sollars. A bed of coarse grit in the Downtonian is correlated with the Holdgate Sandstone of Corve Dale and a thin band at a lower level has yielded *Hemicyclaspis* sp. and other fish fragments.

The *Psammosteus* Limestone crops out in a strong feature running east and west through Barnsland Farm, and is succeeded to the north by sandstones, marls and cornstones in the southern limb of the Cleobury Mortimer Syncline, which further work has now shown to be boat-shaped with a core of Upper Old Red Sandstone rocks. The unconformity proved elsewhere between the Upper and Lower Old Red has not been detected in this syncline.

The Upper Old Red consists of grey and yellowish, rather massive sandstones, red marls and rubbly cornstones. Fossils are scarce, but a bed of olive shales and shaly sandstones in Rowley Brook has yielded some doubtful fragments of *Bothriolepis* and much carbonaceous material. A small *Pachytheca* was obtained from a similar bed on the same strike farther to the west. This appears to be the first record of *Pachytheca* from beds newer than the Middle Lower Old Red.

Coal Measures. —Dr. Pocock finds that the ganister rock which occurs near the base of the Sweet Coal Group (Middle Coal Measures) in the Kinlet area is present in the small tract of Coal Measures in the middle of the Cleobury Mortimer Syncline, and can be traced also at the main outcrop as far south as Cleobury Mortimer Station. South of the station, at Prizeley, Bayton and Mamble, the Sulphur Coal Group (Upper Coal Measures) rests directly on the Old Red Sandstone. In the Mamble and Bayton area a *Spirorbis* Limestone lies some 45 ft. above the Main Coal and about 90 ft. above the base of the measures.

Biggleswade and Huntingdon Sheets

In this area Mr. Dixon has made the following observations.

Corallian (Ampthill) Clay.—Trenches in Waresley Park, 1½ miles north of Gamlingay, reveal a few feet of the highest Jurassic clays there present below the Lower Greensand. The clay seen is not distinctive in colour, and it is without either selenite or pyrites, which occur respectively in the Ampthill and Oxford Clays. It has yielded only lamellibranchs, chiefly large *Gryphaea* and *Ostrea;* but as some of these are freely encrusted with *Serpula,* a feature of Ampthill Clay fossils,[1] and as the Elsworth Rock is present in lower ground a short distance to the north (Meadow Farm[2]) and south (Gamlingay), the clay doubtless belongs to the Ampthill formation.

[1] Wedd, C. B., 'The Corallian Rock of St. Ives (Hunts.) and Elsworth,' *Quart. Journ. Geol. Soc.*, vol. lvii, 1901, p. 83.

[2] Wedd, C. B., *op. cit.*, p. 75.

A fine large ammonite, found in the Chalky Boulder Clay in a well at Eltisley, 3½ miles to the north-east, and presented to the Museum of Practical Geology by Messrs. R. and H. Wale, has been identified as cf. *Perisphinctes vario-costatum* (Buckland) and is probably therefore derived from neighbouring Ampthill Clay.

Lower Greensand.—As exposed in the trenches at Waresley Park, mentioned above, the base of the Lower Greensand is even, except for occasional minor irregularities, and, along a section of many yards extent, is also almost devoid of fragments. These features, though local, are noteworthy in view of the great time-break between the Corallian and the Aptian, of the change of conditions, and of the pebbles, large drift-wood and current-bedding that occur in much of the overlying sands. In fact, if the break had been succeeded by a clay it might have been difficult to locate, or even, in the absence of fossils both below and above, to have been sure of its existence. The break at the base of the Gault, though much smaller, is easier to recognise.

As remarked by previous observers, the Lower Greensand of Cambridgeshire, where found unweathered in wells and borings through the Gault, differs greatly in appearance from outcrop exposures in which the glauconite of the fresh rock has been largely altered to limonite. In its dull greenish colour and in the amount of glauconite, some of the unweathered material is not greatly different from typical ' greensand ' of the Wealden area.

Gault. — Last year it was suggested[1] that most of the Gault of Cambridgeshire is Upper, and that owing to intra-Gault denudation the Lower Gault is possibly absent in places. During the present year more has been learnt of the extent of the Lower Gault. The new observations do not, however, negative the earlier conclusions.

From material in the Sedgwick Museum recently examined by Dr. Spath and Mr. A. G. Brighton[2] the latter finds that Lower Gault (Dentatus Zone) is definitely present at Upware. The previously published records of the fauna had suggested that the whole of the Upware Gault was Upper. At Cottenham a well has been sunk[3] through 19 ft. of clay, of which all but the highest 2½ ft. is Gault *in situ*, into the Lower Greensand, and from the sandy clay with phosphates at the base of the Gault a large indigenous fauna, including many ammonites, has been obtained. The majority of forms appear to be *Hoplites dentatus* (J. Sowerby) and allied species, and the bed may provisionally be correlated with the basement bed at Upware. At Gamlingay also a phosphate-bed with a similar fauna has been found at the base of the Gault, thus confirming previous records.

C. H. DINHAM.

[1] ' The Gault of Cambridgeshire,' ' Summary of Progress for 1932 ' (*Mem. Geol. Surv.*), 1933, App. III, pp. 78-82.

[2] *Geol. Mag.*, 1933, pp. 556-7.

[3] For facilitating the examination of this important section our cordial thanks are due to the engineers, Messrs. Geo. W. Lack and Sons, and their manager, Mr. E. R. Claydon.

3. YORKSHIRE DISTRICT

HEADQUARTERS: YORK

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WILFRID EDWARDS, M.A. } Geologists.
G. H. MITCHELL, Ph.D., M.Sc., D.I.C.

THE resurvey of the Barnsley Sheet (87) has now been completed; that of the Wakefield Sheet (78) has been slightly delayed by the serious illness of Dr. Wray, but what remains to be done is mainly office work and the whole staff will be able to begin fresh areas in the next field-season. Dr. Mitchell has already made a start on the north-western part of the Bradford Sheet (69) in the country around Skipton; some 30 square miles of the area of this Sheet had been resurveyed in 1923 to 1926.

WAKEFIELD AND BARNSLEY SHEETS

Middle Coal Measures.—The work on the Middle Coal Measures has cleared up a considerable amount of confusion in the sequence of the higher beds, due mainly to incorrect identification of sandstones. As a result, new readings of several sections of shafts and boreholes in the Concealed Coalfield lead to a better understanding of the structure there.

The master keys to the succession are the Mansfield Marine Band and, to a less extent, that above the Shafton Coal. The former has been carefully traced and its outcrop, except where interrupted by faulting, can be laid down with confidence on the map. Several new exposures have been found, notably at Stairfoot Brickworks, where a face some 60 yards long shows 3 ft. of cank with many badly preserved goniatites succeeded by shales with *Pterinopecten*, etc. The importance of this locality lies in the fact that the Oaks Rock is exposed some 30 ft. lower in another part of the same brickworks: at a distance of only 200 yards the Rock emerges from beneath the shale to form the dip-slope at Oaks Farm and Colliery. Thus, at the type locality, the position of the Oaks Rock is fixed with reference to the overlying Mansfield Marine Band, the distance of which above the Barnsley and other coals worked beneath it is also exactly known.

In the north Mr. Edwards finds that the Oaks Rock is last seen as a strong sandstone near Newland Hall and does not persist to the east; but the outcrop of the Mansfield Marine Band has been mapped in the Snydale area. The Chevet district has been mapped by Dr. Wray. The names Upper, Middle and Lower Chevet Rock have been given to sandstones lying between the Mansfield Marine Band and the Shafton Coal. The choice is unfortunate since nowhere within the parish of Chevet are there any

measures as high as the Chevet Rock. The fine escarpment on which Chevet Hall is situated is formed by Oaks Rock, as was recognised by A. H. Green.[1] The Upper Chevet Rock might be re-named the Royston Rock, as it is well seen in that village and its position in regard to coal seems clearly definable.

Below the Shafton Coal and marine band the general sequence is fairly regular. Mr. Edwards finds that the Warmfield Rock corresponds with the Ackton Rock at Glass Houghton and there is no local unconformity as was postulated by Green.[2] Above the Shafton Coal and marine band, however, the strata are highly irregular, the coals and sandstones being impersistent. The change in conditions which led to the deposition of unproductive 'Upper Coal Measures' began about this horizon. Moreover the Shafton Coal and its accompanying marine band has been taken as the base of the zone *Anthracomya phillipsi*[3]. There is therefore much to be said in favour of taking the Shafton Coal as the base of the Upper Coal Measures of Yorkshire, though there is as yet little or no evidence of a palaeobotanical break on which to base a correlation with coalfields of the Midlands and south of England.

Both in palaeontology and palaeobotany our knowledge has been increased during the past season. Mr. Stephens has found a series of *Carbonicola* bands in the 150 ft. of measures above the Joan Coal at Bradgate; a fine collection of fossil plants from the roofs of the Haigh Moor coal and a seam 73 ft. below it has been lent by Mr. J. S. Hayes for identification.

The important belt of disturbance running south-west from Morley towards Lofthouse Gate and Snydale, usually in the form of a deep narrow trough, splits up into a fan-like complex of faults south of Normanton: the 'Hark-to-Mobsey' fault near Snydale also breaks up, forming a dichotomising series, the members of which intersect with the ribs of the fan; some of the enclosed areas are as yet untouched by mining operations, but Mr. Edwards has proved the measures present from surface outcrops. He notes that in this complicated area it is a usual feature of the faults which throw down south that the down-thrown strata rise steeply to the south; consequently the effect of the faults is quickly neutralised and the higher measures exist only as small outliers bounded on the north side by the faults.

Mr. Stephens mapped a small section of the Don Valley Fault system just south of Greasbrough, where it was found to be a faulted monocline, thus continuing the structure already proved in the adjacent area to the north-east. The strike of the measures, as the smash is approached from the north-west, develops a pro-

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[1] 'Geology of the Yorkshire Coalfield' (*Mem. Geol. Surv.*), 1878, p. 448.

[2] *Op. cit.*, pp. 456-7.

[3] Wray, D. A., and A. E. Trueman, 'Non-marine Lamellibranchs of the Upper Carboniferous of Yorkshire,' 'Summary of Progress for 1930' (*Mem. Geol. Surv.*), Pt. iii, 1931, pp. 70-92.

minent swing and becomes north to south, and after crossing the first of the fractures even north-east to south-west.

Permian and Trias.—The limestones and marls of the Permian and the overlying Triassic sandstone have been mapped by Mr. Edwards. The wide spread of Lower Magnesian Limestone between Ferrybridge and Kirk Smeaton is dissected by the Wentbridge gorge, which provides the only considerable sections. The Basal Sands are not found south of Pontefract, although the unconformity between the Coal Measures and the Permian is exposed at Carleton and Wentbridge. A discontinuous section along the Wentbridge gorge gives a general idea of the sequence. About 70 ft. of oolitic, compact and shelly limestone are succeeded by about 120 ft. of granular and minutely cellular limestone. The Middle Marls are about 50 ft. thick and crop out in a continuous belt from Ferrybridge to Kirk Smeaton, but are not exposed. There are obscure indications of ancient gypsum-workings near Grove Hall. The Upper Magnesian Limestone, some 80 ft. thick, exhibits the same lithological features as at Brotherton and Knottingley. The lime-burning industry formerly centred at those places has shifted south and is now mainly located between Stubbs and Womersley, where there are great reserves of stone. The Upper Limestone is almost free from magnesia and burns to an agricultural lime of high quality.

About 250 ft. of Bunter Sandstone is calculated to be present in the area surveyed east of Knottingley. It is dug for iron-moulding in Whitley sand-pit, where it is a false-bedded water-deposited medium-grained sand, brick-red in colour.

The Bunter was found by auger-boring to crop out at Smeathalls, and contributes to the evidence on which the shift of the Trias outcrop by the concealed North Pontefract Fault is calculated to be nearly 3½ miles. There are now sufficient sections to enable the outcrop of the base of the Trias to be calculated beneath the Vale of York drift.

Glacial Deposits.—Patches of older boulder-clay were found cutting the high ground between Pontefract and Stubbs. Probably of the same date are the gravels and sands on the Kellington-Snaith ridge, south of Beal.

The wide spread of flat land east of the Permian outcrop is occupied by a considerable thickness of silts and clays, and, where the Aire and Went breach the limestone, deltaic sands. At Whitley sand-pit they overlie a Trias surface on which are scattered beautifully wind-facetted pebbles, cobbles and boulders. These originated in their polished form not from the Trias, but by the subaerial attrition of a nearby capping of gravel. Their freshness leads to the inference that a desert or steppe area was submerged by the water which brought the Vale of York drift. The laminated clays in the drift suggest the seasonal melting of ice and snow, while the abundance of coal fragments indicates a

westerly source of some of the water. If this was glacial melt-water it belonged to the last glaciation which survived in Yorkshire.

Wind-facetted cobbles similar to those at Whitley are found scattered over the fields or embedded in superficial clays over a wide area between Whitley and Wakefield. Excellent examples lie in the clay at the top of the Ackton Hall Colliery brick-pit at South Featherstone.

C. E. N. Bromehead.

4. LANCASHIRE DISTRICT

HEADQUARTERS : MANCHESTER

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L. H. TONKS, M.Sc.
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REVISION of Sheet 84, Wigan, was completed in the early part of the year and standards were prepared. This work is now complete and the maps are being published. Mr. Tonks and Mr. Jones were engaged in the primary survey of the Highlands of Scotland in May, June and July. In the autumn Mr. Whitehead joined the staff and mapping was continued by Messrs. Tonks, Jones and Whitehead in Sheet 75, Preston, with the object of preparing a set of standards during the winter.

The assembling of information for a water-supply memoir on South Lancashire has been embarked upon, so as to avoid delay in the production of the same when the revision of the area is complete.

WIGAN DISTRICT

Carboniferous. — Dr. Wright has now examined the bulk of the fossil material obtained from the mines of the Wigan district, and finds that the subzones established in the Manchester and Oldham areas are traceable westward in so far as access can be had to the beds in which they occur. The limits of these subdivisions are, however, indefinite, and they are of stratigraphical value only in so far as they confirm the group correlation of coal seams already established by comparison of vertical sections and continuity of mining. Definite and exact correlation can be established, however, on three horizons. The well known bed with *Carbonicola pseudorobusta* Trueman above the Arley Mine can be identified wherever visible; the Wigan Six Foot Mine has *C. oslancis* Wright and the associated forms characteristic of the Trencherbone and Oldham Great Mines, and may be confidently identified with them. The Park Mine of Ince has the distinctive fauna of the Ashclough Mine, including *C. concinna* Wright, *C. radiata* Wright and *Anthracomyas* of the *librata* group.

A fairly extensive study of the fresh-water shells of the Lower Coal Measures has also been carried out, and has produced results which are published in Part II of the *Summary of Progress* for 1933.

In the early part of the year Mr. Tonks was engaged in the completion of the six-inch maps of the area west of Wigan. Mr. Jones spent the spring in completing the revision of the six-inch

EX BIBL. UNIV. EDINBURGEN

maps of his area in Sheet 84 (Wigan). These maps are now being prepared for or are in the press. We are further indebted to the officials of the colliery companies for much new information and for their assistance in elucidating the complex faulting of certain areas. They have also readily provided facilities for the examination of tunnel sections and the collecting of fossils. This work is now also completed for the Wigan Sheet.

Preston District

Carboniferous and Triassic.—In the area east and south-east of Preston surveyed by Mr. Tonks the Carboniferous rocks are not well exposed but appear to be subject to minor folding developed between the axes of the Clitheroe Anticline and the Burnley Syncline.

It is of interest to record the fact that the Triassic sandstones are apparently unaffected either by these minor folds or by the main anticlinal. This is in marked contrast with the relationships found in South Lancashire, where the Permo-Triassic rocks were affected by the downwarp into the Cheshire basin to about half the extent that this movement affected the underlying Carboniferous.

Mr. Jones revised the area east of Chorley and Brindle and completed the maps adjacent to the Rossendale area, which were begun in 1924.

The northern part of Anglezarke Moor and Withnell Moor has been fully investigated and consists entirely of the various members of the Third Grit, principally the Main Third or Fletcher Bank Grit and the overlying Helmshore Grit. The former is probably over 250 ft. thick and contains occasional impersistent shale bands. The Helmshore Grit has been found to be absent on the north side of the Blackburn Syncline.

The ground from Heapey to Wheelton and east to Chapels has been found to consist almost entirely of Haslingden Flags and Rough Rock and not Lower Coal Measures as shown in the old maps. The flags are largely shaly and are everywhere thin, a striking contrast with their development about Cartridge Hill and farther south on Winter Hill. The Haslingden Flag Marine Band has only been found in one locality but this is probably due to lack of exposures.

The Rough Rock presents its usual lithological characters but over this area the Sand Rock Mine is absent.

The Holcombe Brook Coal has been worked between Brinscall and Withnell and again between Healey Nab and White Coppice. The overlying marine band appears to die out coming north towards White Coppice and is absent in the Brinscall exposures. It is found again in the valley of the Lostock at Wheelton.

Glacial.—Mr. Whitehead surveyed an area west of Preston in which Triassic rocks are entirely concealed by superficial deposits.

The greater part of this area is covered by boulder-clay. This is a reddish clay, fairly stiff but containing a large proportion of sand-grains and, in most places, many stones. The commonest erratics consist of Carboniferous limestone, and of igneous rocks and indurated sediments from the Lake District; but several granite boulders of Scottish origin were observed.

The boulder-clay has sandy patches, and in places, *e.g.* east of Salwick Hall, south-east of Cottam and near New Lea Hall, definitely bedded sands crop out. As far as the local evidence goes, however, these might be mere lenticles in the boulder-clay rather than parts of a definite and continuous group of ' Middle Sands ' between an ' Upper ' and a ' Lower ' Boulder Clay.

Mr. Tonks reports that the Millstone Grits, folded along N.E.-S.W. axes, make the ridge and furrow type of topography but that farther west on the Triassic plain the solid rocks make no contribution to the surface features.

In the steep-sided banks overlooking the wide alluvial flats of the Ribble, glacial sands overlain by a stiff boulder-clay are occasionally exposed and appear to have a more or less continuous distribution. It is likely that their existence between two sheets of boulder-clay indicates readvance, but of what magnitude is not yet known.

In Mr. Jones' area the drift is thin except in the low ground about Chorley and to the immediate north where it is probably of considerable thickness. It is here morainic in character. A most interesting system of drainage channels has been mapped ranging from 540 ft. down to 300 ft. They are associated with small local lakes formed by ice to the west and north-west holding up the drainage of the higher ground of the Anglezarke moorland.

W. B. Wright.

5. CUMBRIAN DISTRICT AND FOREST OF DEAN

T. Eastwood, A.R.C.Sc., District Geologist.
F. M. Trotter, D.Sc., Senior Geologist.
S. E. Hollingworth, M.A., D.Sc.
W. C. C. Rose, M.Sc. } Geologists.

THE members of the Cumbrian staff were engaged for several months on the preparation of exhibits for the new Museum to illustrate the geology of Northern England and the Isle of Man. Mr. Rose was largely responsible for the cases dealing with the older Palaeozoic rocks, Dr. Trotter for the Lower Carboniferous, Mr. Eastwood for the Upper Carboniferous, and Dr. Hollingworth for the Permo-Trias, Lias, Pleistocene and Recent deposits.

Routine field-work in Cumberland ceased at the end of 1932 but Dr. Hollingworth paid a visit during the summer of 1933 to the Manchester Water Works in order to complete his observations on the tunnels from Haweswater. The northern tunnel, about 5 miles long, pierces the Borrowdale Volcanic Series for the greater part of its length, but emerges on the south through the Coniston Limestone Series at Stockdale Farm near the head of Long Sleddale. A detailed record of this tunnel with a representative set of specimens has been obtained which we hope will assist in the elucidation of the sequence and structure of the Borrowdale Volcanic Series.

A measured section was also made of a tunnel some three-quarters of a mile in length through Silurian rocks about two miles south of Stockdale.

Dr. Hollingworth also examined the cores of a number of borings for gypsum in the New Red Sandstone near Carlisle.

The preparation of the standard six-inch maps of the Cockermouth and Gosforth sheets is being pushed forward. Those pertaining to Gosforth have been so far advanced that the preparation of the one-inch map may be commenced.

A considerable amount of time has been devoted—mainly by Drs. Trotter and Hollingworth—to a report dealing with the classification of the Carboniferous rocks of northern England.

Forest of Dean

The Forest of Dean is one of the few remaining coalfields that have not been surveyed on the six-inch scale. The results of the primary survey were published on the Old Series One-inch maps 43 S.W. and S.E., and 35 N.E. and N.W. between the years 1845-72 and were the work of various geologists, but no explanatory memoir was written. Sheet 233 of the New Series One-inch map includes the whole of the coalfield, but the outcrops of some of the underlying rocks transgress into ground covered by the adjoining sheets to the east, south, and north.

Dr. Trotter has been mainly concerned with the north-eastern portion of the coalfield, but has also mapped some of the marginal rocks near Cinderford. Mr. Rose has been employed along the northern edge of the field around Mitcheldean.

The sequence of formations is given below in descending order :—

Coal Measures
Drybrook Sandstone
Main Limestone
Lower Limestone Shales
Old Red Sandstone

The rocks are arranged in a basin of which the eastern rim is steep—in places actually passing through the vertical—whereas the dip on the west is comparatively gentle. On the north the symmetry of the basin is further marred by folding which has given rise to a subsidiary anticline and has accentuated the downfold on the east to form the Wigpool Syncline. The effect of these structures is to give a heart-shaped outline to the coalfield. Faults, while of no great magnitude, are of some hindrance to mining, but a steep monocline, ranging south-south-west from Cinderford, is a very serious obstacle and renders certain portions of the coal seams unworkable at present.

Old Red Sandstone.—Mr. Rose remarks that the Old Red Sandstone near Mitcheldean consists mainly of dull red or reddish-brown sandstones, frequently calcareous, with bands of shale or mudstone and cornstone; the most readily traceable bed, however, is a quartz-conglomerate up to 100 ft. in thickness which occurs between 300 and 400 ft. from the top of the formation. This conglomerate gives rise to a sharp feature which is continuous from Mitcheldean around the Wigpool Syncline to Hope Mansel, thence along the northern side of Howle Hill to Bulls Hill, and reappears across the Wye near Goodrich. Dr. Trotter has traced the same conglomerate from Little Dean, east of Cinderford, to Upper Soudley.

Lower Limestone Shales.—This old established term is somewhat of a misnomer here, for limestone frequently predominates over shale. The rocks of this subdivision reach about 180 ft. in thickness. They appear to succeed the Old Red Sandstone with perfect conformity, and, being less massive than the rocks above and below, give rise to a shallow depression which may be easily followed.

The best section is furnished by the now disused quarry of the Mitcheldean Cement Works, 550 yds. south-west of Mitcheldean Church. There, fairly thick-bedded, grey, crystalline limestones are interbedded with flaggy, impure, porcellanous limestones and calcareous shales and mudstones. Certain beds are richly fossili-

ferous; some are oolitic; others are gritty, especially near the junction with the Old Red Sandstone. Near the top the limestones are much dolomitized and afford a gradual passage upward into the Lower Dolomite of the Main Limestone.

Main Limestone.— This group of rocks, which is the chief repository of the iron-ore of this district,[1] has been divided in ascending order into the Lower Dolomite, the Crease Limestone, and the Whitehead Limestone.

The Lower Dolomite, in the neighbourhood of Mitcheldean and Wigpool, consists of about 250 ft. of massive, grey, compact dolomite with occasional bands of crinoidal limestone near the top. There are many excellent exposures in the Wigpool Syncline and the rock is extensively quarried for road-metal near Drybrook.

The Crease Limestone is about 100 ft. thick and is rather coarser grained than the beds below. The dolomitization of the Lower Dolomite is thought to be contemporaneous, whereas that of the Crease Limestone is believed to be subsequent,[2] for the latter rock includes patches of unaltered pale-grey, crinoidal limestone, occasionally very fossiliferous.

The Whitehead Limestone near Mitcheldean is from 30 to 60 ft. in thickness and includes compact, gritty, and oolitic limestones, separated by marly bands, with, in the higher part, seams of sand that afford a passage into the overlying Drybrook Sandstone. The most characteristic rock, however, is a hard, white or creamy porcellanous limestone which locally contains abundant remains of the calcareous alga *Mitcheldeania*. A shallow quarry, 750 yds. W.12°N. of Mitcheldean Church, is the best exposure, but the limestone is well developed elsewhere in the Wigpool Syncline. Between Drybrook and Lydbrook both it and the Crease Limestone are concealed by the overstep of the Coal Measures. Both, however, reappear near Hangerberry.

Drybrook Sandstone.—Previously regarded as Millstone Grit this thick series of sandstones was relegated by Vaughan[3] to the Carboniferous Limestone Series, for the lower part of it appears to be of Upper Seminula age. Dr. Sibly, who adopted the name Drybrook Sandstone, holds the same view,[4] with which we concur.

The sandstones are reddish-brown in colour, and are usually soft, but also contain bands of white ganister-like sandstone. They frequently include thick lenses of quartz-conglomerate in addition to thin seams of purplish-green or white clay. These conglome-

[1] See 'Special Reports on the Mineral Resources of Great Britain' (*Mem. Geol. Surv.*) vol. x, 'The Haematites of the Forest of Dean and South Wales,' 1919, by T. F. Sibly, and ed. 2, 1927, revised by W. Lloyd.

[2] Sibly, T. F., *op. cit.*

[3] Vaughan, A., 'The Palaeontological Sequence in the Carboniferous Limestone of the Bristol Area,' *Quart. Journ. Geol. Soc.*, vol. lxi, 1905, pp. 251-2.

[4] 'The Carboniferous Succession in the Forest of Dean Coalfield.' *Geol. Mag.*, 1912, p. 420.

rates are not unlike that forming a conspicuous band in the Old Red Sandstone. The full thickness is unknown but 350 ft. of the Drybrook Sandstone is present three-quarters of a mile north-west of Mitcheldean and at least 500 ft. near Hangerberry farther west. It is noteworthy that at the latter locality conglomerates are rare or absent.

Coal Measures.—The Coal Measures are unconformable to the rocks below, which they overstep in several places. Our work in the coalfield has not progressed sufficiently to give a complete sequence of the measures. The following table, however, gives the strata investigated, for the most part, by Dr. Trotter :—

Section of the Coal Measures

Twenty Inch Coal	1 ft. 8 in. to 2 ft. 2in.
(A coal 6-10 in. thick lies from 1-4 ft. above, and in places is worked with, the Twenty Inch Coal)	
Shales and sandstones with a thin coal near top ...	40 to 50 ft.
Lowery Coal	3 ft.
(Splits towards the west into two seams of about equal thickness)	
Shaly strata with thin coal	40 to 50 ft.
Starkey Coal	10 in. to 2 ft.
Shale and fireclay	5 to 10 ft.
Sheftnell or Lower Starkey Coal	10 in. to 1 ft. 6 in.
Shale, fireclay and sandstone with a thin coal ...	20 to 40 ft.
Rockey Coal	1 ft. 4 in. to 2 ft. 2 in.
Shale and sandstone with a thin coal	40 to 90 ft.
Churchway High Delf, with one to three partings of shale	5 to 6 ft.
Shale with some sandstone	30 to 40 ft.
No Coal, main part of seam	10 in. to 1 ft. 9 in.
(Thin coals 1 to 2 ft. above and below the main portion left in as roof and floor).	
Sandstone	30 to 60 ft.
Brazelly Coal, rarely worked, with 2 or 3 partings	2 to 3 ft.
Gritty sandstone with subordinate shale bands and two thin coals	600 to 800 ft.
Coleford High Delf	2 ft. 6 in. to 6 ft.
Gritty and pebbly sandstones with clays	250 to 350 ft.
Trenchard Seam	1 to 2 ft.
Basal conglomerate	0 to 40 ft.

That portion of the Coal Measures up to the base of the Coleford High Delf is sometimes referred to as the Trenchard Measures. Another subdivision, used locally, is made at the Churchway High Delf, strata up to the base of that seam being known as the Steam Coal Measures, while the rest are referred to as Household Coal Measures.

According to Mr. Rose the Trenchard Measures occupy part of the Wigpool Syncline and also form outliers resting on the Lower Limestone Shales at Howle Hill, near English Bicknor, and, west of the Wye, at Courtfield. The Trenchard Seam appears to have been worked near Great Howle but is usually of little value.

The Coleford High Delf is one of the most important seams in the coalfield and its properties are being investigated by the officers of the Fuel Research Board. Dr. Trotter states that in the north-eastern part of the coalfield it is being actively exploited at Eastern United Colliery, Ruspidge, and on a smaller scale at Addis Hill, while a shaft is being sunk to it at a point about 1½ miles south-east of Ruardean. The sandstone above the Coleford High Delf frequently contains beds containing pellets of shale and pieces of coal which indicate that much penecontemporaneous erosion accompanied deposition.

The Household Coals have been worked from innumerable small pits along their outcrops and on a larger scale from Trafalgar, Crumpmeadows, Foxes Bridge, and Lightmoor collieries in the north-eastern part of the coalfield, but with the exception of the last all the larger pits are now abandoned.

T. EASTWOOD.

6. NORTHUMBERLAND AND DURHAM DISTRICT

HEADQUARTERS : NEWCASTLE-ON-TYNE

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V. A. EYLES, B.Sc. } Geologists.
W. ANDERSON, M.Sc. }

FIELD work in 1933 continued the programme of last year. Mr. Burnett was engaged in Carboniferous Limestone country in the northern half of Sheet 14 (Morpeth), while the revision of Sheet 8 (Elsdon) is now approaching completion. Mr. Fowler, having finished his preliminary draft of the Rothbury Memoir, resumed field-work round Falstone, in the North Tyne valley. Mr. Anderson was able to start earlier, and revised considerable areas in Upper Redesdale before the season ended. Mr. Eyles took no part in the work, being engaged in the London office throughout the year.

The prolonged drought led to several water-bores being put down in the agricultural country north-west of Newcastle. Examination of the cores enabled us to give considerable assistance to the promoters; as noted in previous years, limestones, rather than grits or sandstones, were found to be the chief water-bearers.

Silurian. —In Sheet 8 inliers of steeply inclined shale with thin greywacke bands have long been known in the lower reaches of Ramshope, Lumsdon and Coomsdon burns. The latter two have yielded Monograpti, for which Mr. Anderson has discovered a new locality in the Ramshope Burn : specific determinations are not yet to hand.

Cementstone Group.—The basal member of this assemblage —the Lower Freestones—is well shown throughout the Upper Redesdale country. As seen towards the foot of Coomsdon and Bateinghope burns, the lower layers of massive iron-stained or ochre-spotted sandstone (perhaps 300 ft. in all) are associated with soft purplish and greenish marls, frequently crowded with ochreous concretions. Above these is the more typical development of the Cementstone Group, about 500 ft. thick. As usual, shales with innumerable thin cementstone ribs predominate; sandstones are quite subordinate, save in the uppermost beds. Particular interest attaches to the very highest beds, immediately under the Fell Sandstone. In the Coomsdon Burn these show a sequence of nodular algal limestones with shale partings resting

on an 11-ft. *Ortonella* limestone with a layer of fish-remains; and 4 ft. below this is a foot of limy grit, crinoidal in the upper part. When traced southwards the algal member dies away and the crinoidal grit gets thicker, while in Hawk Gill, 3 miles to the east-north-east, the whole sequence is represented by a conglomerate of limp grit and algal pellets. Nearly 150 ft. below, a 12-in. band of *Serpula* shale has a wide distribution, the best exposures being in the Chattlehope and Coomsdon burns.

Fell Sandstone.— This group occupies all the high ground between the Rede and Black Blakehope Burn. There are excellent sections in Coomsdon Burn, where the massive sandstones, some 600 ft. in all, are more shaly and less gritty than to the north-east; thin coals and fireclays are not uncommon between the beds.

Scremerston Coals. —Emendations in the mapping of these strata are not often needed, for the original survey was very carefully done, and the field-sections are disconnected and rarely satisfactory. But Mr. Fowler finds that some change is certainly needed in the interpretation of the fine Sundaysight Cleugh section, north of the farm. Here there is a syncline, with repetitions of the Redesdale Limestone on the eastern limb. The highest strata were mapped as the Fourlaws Limestone with its associates, but there can be no doubt that they represent much higher beds faulted in; they are greenish shales and sandstones, under which are two limestone beds, both recurring in the Tarret Burn to the west.

Many exposures of the highly fossiliferous Redesdale Limestone are known in the district. In Smithy Cleugh, below the underlying Redesdale Ironstone Shale, is a band of limy mudstone, not unlike a decalcified limestone, with marine fossils in great variety. This has proved a useful confirmation of the Redesdale position elsewhere, as, for instance, in the Sundaysight section mentioned above. The Fourlaws Limestone is not so well characterised, but here we find the overlying Fourlaws Coal a useful guide; the seam has been wrought at many points, and at least 26 in. can still be seen alongside a streamlet half a mile south-south-east of Highgreen.

Upper Limestones.—Mr. Burnett's attention was restricted to these measures, as developed west of Morpeth, in Sheet 14. The ground is heavily drift-covered, and the only natural section of consequence is that in the Hart Burn. Three limestone horizons can be made out here, of which the middle and thickest (28 ft.) is the Pigdon of Sheet 9. To the south-east recent borings at Eachwick Red House, and East House, Dissington, pass through much the same strata, but difficulties in correlation render it advisable to defer detailed readings of the sequence. Another bore, at Stam-

fordham, started in the Corbridge Limestone and is being carried down towards the Little Limestone. A fourth water-boring, at Hazon, north of the Coquet (Sheet 9) is still proceeding, and examination of the cores is in Mr. Fowler's hands. This bore started below the Lickar position, and gives a good account of strata not otherwise seen in the district, above the Great Limestone. At least four fossiliferous horizons have been noted above the Cushat, or Little Limestone; they can be correlated with others got in the Shilbottle country to the north, but their equivalents far to the south, in the Font Valley, have yet to be determined.

R. G. CARRUTHERS.

(B)——SCOTLAND

1. DUMFRIESSHIRE AND AYRSHIRE

J. E. Richey, M.C., B.A., District Geologist.
J. B. Simpson, D.Sc., Senior Geologist.
A. G. MacGregor, M.C., B.Sc., Geologist.

DURING the past field season the revision of the post-Silurian rocks of Sheet 15 was completed. The area north-west of the Southern Uplands Fault between Penbreck and Lethans, chiefly occupied by Old Red Sandstone, was resurveyed by Dr. Simpson. The investigation of the Sanquhar Coalfield was concluded by the geologists above-named, with the co-operation of Dr. Pringle. The Permian lavas and sediments of the northern part of the Thornhill basin, together with underlying Carboniferous rocks, were re-examined by Dr. Pringle and Mr. Richey.

Carboniferous Limestone.—These strata are exposed in stream sections near Penbreck farmhouse, and form a small syncline bounded by faults in an area chiefly occupied by Lower Old Red Sandstone sediments and lavas. In the Penbreck Burn, north of the farmhouse, the Lower Limestone group, including the Hawthorn (Hurlet) and McDonald (Upper Hosie) limestones, is succeeded to the south by the basal beds of the Limestone Coal group, including the McDonald Coal and Johnstone Shell-bed. An old pit a short distance west of the burn appears to have been sunk to the McDonald Coal. Downstream from, and faulted against, the Johnstone Shell-bed, higher beds are exposed, including three limestones belonging to the Upper Limestone group. They dip southwards, but reappear, dipping to the east, on the western side of the syncline in the Glenmuir Water, west-south-west of Penbreck. No coals higher than the McDonald seam are known, but one or more of the thick coals of the Muirkirk sequence might be expected to occur beneath the area occupied by the Upper Limestone group.

A highly fossiliferous bed exposed in the Enterkin Burn north-west of Inglestone farmhouse near the northern end of the Thornhill basin indicates the presence of Lower Carboniferous strata at this place beneath unconformable Upper Carboniferous beds. Among other fossils, determined by Dr. Pringle, are the following : *Buxtonia scabricula* (Mart.), *Pugnax pleurodon* (Phill.), several species of *Productus*, *Spirifer* cf. *bisulcatus* (J. de C. Sow.) *Aviculopecten interstitialis* (Phill.), *Grammatodon semicostatus* (M'Coy), *Syncyclonema sowerbyi* (M'Coy), and *Bucaniopsis decussatus* (Flem.). The fauna appears to indicate that the beds are not lower than the horizon of the Foul Hosie Limestone of the Lower Limestone group.

Millstone Grit.—In last year's *Summary of Progress* attention was directed to the occurrence of a marine bed overlying bauxitic clays near the base of the Carboniferous strata of the Sanquhar Coalfield. The marine bed was considered by Dr. Pringle to be Lower Carboniferous on the evidence afforded by its fauna.[1] The bauxitic clays were on these grounds tentatively assigned to the lower part of the Millstone Grit. As a result of further collecting, it is now clear that the bauxitic clays should be placed near the top of this series, and may therefore be regarded as equivalent to the lithologically similar deposits of North and Central Ayrshire. This conclusion is based upon the discovery by Dr. Pringle of Upper Carboniferous plants below the marine bed, which can therefore no longer be regarded as Lower Carboniferous in age. The plants were collected from the Polneul Burn, and include the following: *Alethopteris lonchitica* (Schloth.), *Neuropteris schlehani*? Stur., and species of *Calamites*, *Cordaites*, and *Sphenophyllum*.

In an instructive section in the adjacent Polhote Burn the well known plant-break of Kidston has been closely located. The details are as follows:—

		Ft.
Upper Carboniferous	Sandy shales with *Sphenopteris* sp., *Calamites carinatus* (Sternb.), *C. undulatus* (Sternb.), and *Lepidodendron lycopodioides* (Sternb.), etc. ...	10
	Bands of bauxitic clay, and sandstone pebbly at base, with pipes of sand descending into underlying beds	15
Lower Carboniferous	Soft shales, etc., with marine fossils: Orthotetid, species of *Productus* and *Spirifer*, and *Bucaniopsis decussatus* (Flem.)	2½
	Red and greenish shales, etc., with plants: *Sphenopteris taitiana*? Kidst., and *Sphenophyllum tenerrimum* Stur.	15
Ordovician.	Weathered greywackes.	

Coal Measures.—The Upper Carboniferous marine bed referred to above was first discovered by Mr. David Tait in 1913, and is taken as the base of the Coal Measures of the Sanquhar basin. In the Barr Burn, 1½ miles W.S.W. of Sanquhar, an outcrop of marine shale overlying bauxitic clay is probably Tait's marine band. Plants are associated with the marine fossils, and additional forms to those already recorded[2] are: *Sigillaria elegans*? Sternb., *S. tessellata* Brongn., and species of *Calamites* and *Cordaites*. On account of the occurrence of these Upper Carboniferous plants, the species previously referred to *Zeilleria moravica* (Ett.) has been re-examined, and should now be referred to a species of *Rhodea*.

[1] 'Summary of Progress for 1932,' Pt. i (*Mem. Geol. Surv.*), 1933, pp. 69-70.
[2] *Op. cit.*

In the Thornhill basin[1] a bed of reddened shales, rich in ' mussels,' was located in the Carron Water east of Carron Bridge railway station. The lamellibranchs collected are determined by Dr. Pringle as: *Carbonicola acutella* Wright, *C.aquilina* (J. de C. Sow.), *C.* cf. *concinna* Wright, *C.* aff. *faba* Wright, *C.* cf. *regularis* Trueman, *C. sp.* [Cf. *C. carissima* Wright], *Naiadites producta* (Brown), *N.* cf. *triangularis* (J. de C. Sow.), and *Anthracomya* sp. These appear to indicate a high position in the Modiolaris Zone, the top of which lies above the Kirkconnel Splint Coal in the Sanquhar sequence. No coal is known to outcrop in the Thornhill basin, but, since part of the Similis-Pulchra Zone, together with the underlying Modiolaris and Ovalis Zones, is known to be present, there are possibilities of coal being discovered by means of bores.

J. E. RICHEY.

[1] Pringle, J., and J. E. Richey, ' Carboniferous Rocks of the Thornhill Basin, Dumfriesshire,' ' Summary of Progress for 1930,' Pt. ii (*Mem. Geol. Surv.*), 1931, pp. 25-33.

2. CENTRAL COALFIELD AND FIFE

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Central Coalfield

THE preparation of the economic memoir on Area I of the Central Coalfield, comprising the Kilsyth and Kirkintilloch districts, is well advanced. Dr. Robertson and Mr. Haldane have spent some time in the field on revision work for this purpose, and the examination of a number of bores recently put down in the Kilsyth area has added considerably to our knowledge of the succession. This work completes the chain of correlation connecting the Carboniferous Limestone Series of the Glasgow district with that of Fife.

The area in question is of much economic importance. It numbers amongst its mineral products such varied materials as anthracite, coking coal, steam coal, clayband and blackband ironstone, limestone, building stone, alum shale, moulding sand, building sand, brick clays, fireclays and high-class road stone.

In the Limestone Coal Group the continuity of the principal coals and other distinctive horizons between the Glasgow and Stirling coalfields is now definitely established. Comparison shows that most of the important seams are situated in the upper half of the group in both areas; but there is a certain degree of abnormality in the succession in the neighbourhood of Kilsyth.

In conjunction with the officers of the Fuel Research Division further investigation on the development of anthracite in the proximity of the whin sills is in progress, and an extensive examination of the workable coals of the district is being undertaken at the Fuel Research laboratories in Glasgow.

Much additional underground information has been received and collected, amongst which is evidence of the continuity of the Lenzie-Torpichen whin dyke between Cadder and Lenzie in the workings of the Woodilee Colliery; an east-and-west whin dyke has also been proved under Balmore Haughs in Carron Company's ironstone workings at Cadder.

A new edition of Lanark 8 N.W. has been prepared by Mr. Allan and is now in the press.

Fife Coalfields

No field-work was done in Fife during the present field season but Messrs. Allan and Knox completed in the early part of the year the second of the series of three economic memoirs dealing

with the Fife Coalfields, and commenced the preparation of the third volume dealing mainly with the Coal Measures of Dysart and Leven. This area includes nine six-inch quarter sheets of which two have been published and two are in the press; the remainder are being prepared for publication. The examination of the numerous plans and bore journals kindly supplied by the various mining companies has occupied some time, but has helped greatly in the elucidation of the geological structure and succession, particularly within the area occupied by the Productive Coal Measures. Although the information available in the region to the north of these measures is somewhat scanty, it is satisfactory to report that a complete succession of the Upper Limestone and Limestone Coal groups has been established.

M. MacGregor.

3. WEST HIGHLAND DISTRICT

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} Geologists.

FIELD work was carried out by the above unit for three months during the summer in various parts of Sheet 52 (Sunart) where considerable progress had been already made in 1931, and the survey of the Sheet is now nearing completion. Mr. Tonks and Mr. Jones were lent from the Manchester unit for the Highland field season. Dr. Kennedy was engaged in Museum work in London during the whole of the year.

The mapping of the Moine Schists and injection-gneisses around Loch Shiel and Loch Moidart was first completed by the five geologists named, and was continued around Strontian by Mr. Jones. In Morvern the survey of the granite was finished by Messrs. MacGregor and Richey, and the investigation of the Tertiary basalt lavas was carried to a conclusion by Messrs. Simpson and Tonks.

Moine Schists, etc.—North of the North Channel of Loch Moidart the Carna Pelitic[1], accompanied on either side by psammitic schists, has been traced northwards of Eilean Shona to the northern margin of Sheet 52, where the belt is much reduced in width.

North of Loch Shiel and east of Glen Moidart alternating belts of psammitic, semipelitic and pelitic schists, everywhere containing abundant pegmatites (injection-gneisses), are involved in complicated large-scale folding. A prominent synclinal fold with a N.-S. axis closes to the north around Cruach a'Ghaill. The easterly limb where it reaches Loch Shiel turns north-eastwards along the shore of the loch to the Glenaladale valley. There the strike again swings round to the north. A broad synclinal fold has its centre near the summit of Beinn Gaire and is separated by faulting from the Cruach a'Ghaill syncline.

North-west of Loch Shiel the psammitic bands have clean-cut junctions against pelitic on one side and show intercalations of pelitic on the other. On Beinn Gaire bands of semipelitic or pelitic schist contain abundant sillimanite knots and lenticles.

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[1] 'Summary of Progress for 1922' (*Mem. Geol. Surv.*), 1923, p. 93.

The boundary of the augen-gneiss of Sgùrr Dhomhnuill[1] against the schists is usually found to be indefinite, the felspar porphyroblasts becoming more and more sparse till they fail altogether.

Small intrusions of hornblende-schist are plentiful in the augen-gneiss and surrounding country, and are cut by quartz and pegmatite veins.

Appinite sheets are especially abundant around Beinn Gaire, and individual intrusions have been traced for a mile or more on the eastern side of the Beinn Gaire syncline. They follow the strike of the schists, but usually cut across the foliation at low angles. In addition to types rich in hornblende and biotite there is at least one occurrence of lustre-mottled (poikilitic) pyroxene-olivine-biotite rock which contains abundant partly serpentinized olivine, and recalls certain rocks of the scyelitic suite of Sutherlandshire.[2]

Morvern Granite, etc.—The tonalite—granodiorite junction[3] has now been traced across the head of the Loch Sunart valley southwards across the middle of the Glas Bheinn—Fuar Bheinn ridge to the valley (Glengalmadale) north of Camas na Croise. No sharp contact has been observed, but the change from one rock-type to the other takes place within a few feet. South-south-east of Fuar Bheinn the junction is largely obliterated by broad bands of biotite-granite. In the ground on either side of the Loch a'Choire valley the centrally situated mass of biotite-granite has most intricate junctions with the granodiorite. The granite penetrates the granodiorite in long anastomosing bands or tongues from a few feet to many hundred yards in width. For about a mile east and south of Loch a'Choire granodiorite is still the dominant rock. Tongues of granite also extend down the precipitous western slopes and corries of Glengalmadale and, cutting abruptly across the outer margin of the tonalite, form large and small-scale intrusion-breccias with siliceous schists.

Quartz-dolerite dykes and bosses are widely though sparsely distributed over the area. An unusually extensive dyke, 150 ft. in width, has been traced continuously for two miles through the granite-complex south-eastwards of Glas Bheinn. A dense concentration of thin camptonite and monchiquite dykes with a general W.N.W. to N.W. trend traverses the granite-complex on both sides of Loch a'Choire.

Tertiary Lavas.—In Morvern a somewhat monotonous succession of olivine-basalt lavas is succeeded at a height of about 1000 ft. from the base by a number of flows of mugearitic affinities associated with two flows of felspar-phyric basalt. The lower of

[1] 'Summary of Progress for 1931,' Pt. i (*Mem. Geol. Surv.*), 1932, p. 58.

[2] Read, H. H., 'The Geology of Central Sutherland' (*Mem. Geol. Surv.*), 1931, pp. 167-9.

[3] MacGregor, A. G., and W. Q. Kennedy, 'The Morvern-Strontian Granite,' 'Summary of Progress for 1931,' Pt. ii (*Mem. Geol. Surv.*), 1932, pp. 111-113.

the felspar-phyric lavas caps the great cliff between Bealach na Sgàirn and Lochan Sgùrr na Gréine, and the upper encircles Sìthean na Raplaich below the 1,750-ft. contour-line.

Economics.—On the north side of Loch Sunart a felspathic pegmatite vein with some quartz, 25 ft. in width, was once worked at Sròn na Saobhaidh. The material was used in the manufacture of enamel ware, but proved unsuitable owing to the presence of small quantities of biotite. Another pegmatite vein, a short distance north of Ardarie, has been worked for muscovite, but the mineral proved difficult to extract without blasting, which led to the shattering of the mica plates.

J. E. Richey.

4. SHETLAND

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T. Robertson, B.Sc., Ph.D., A.Inst. M.M.
J. Phemister, M.A., D.Sc..
D. Haldane, B.Sc.
} Senior Geologists.

J. K. Allan, M.A., B.Sc.
J. Knox, B.Sc.
S. Buchan, B.Sc.
} Geologists.

DURING the past field season considerable progress was made with the primary mapping of Shetland. Dr. Robertson completed the survey of Whalsay and the Out Skerries; Dr. Phemister in North Maven has joined up with Mr. Haldane who has been working northwards from Mavis Grind. Messrs. Wilson, Knox and Buchan were mainly engaged on the Old Red Sandstone sediments of the Walls peninsula. Mr. Knox mapped the Fair Isle and Foula was mapped by Mr. Buchan. Mr. Allan commenced work on the Old Red Sandstone volcanic rocks of the Esha Ness district. A band of flags with well preserved fish remains was discovered in the Melby district. Previous to this the only organic remains obtained from the sediments of the Walls peninsula were some rather fragmentary plants of Old Red Sandstone type.

Metamorphic Rocks.—In the area between Ollaberry and Ronas Voe Dr. Phemister recognises the following west to east sequence of the metamorphic rocks:

Hornblendic gneiss and variable granulitic gneiss.
Muscovite-schist with garnet and chloritoid in parts.
Siliceous group mainly of flaggy quartzites.
Green schist group.
Calcareous group varying from quartzose schist to siliceous limestone.
Flaggy quartzite.
Foliated acid and subacid igneous rocks.

Two narrow, easily identifiable belts border the muscovite-schist group; on the west is a siliceous granulite with pink felspar 'pebbles,' and on the east a belt of hornblendic and calcite-epidote-schists.

In the hornblendic gneiss, which forms a wide outcrop around the upper part of Ronas Voe, the dip and strike are very variable, but in the other members of the series the strike is dominantly north-north-east and the dip varies from about 50 degrees in the west to vertical in the east. Isoclinal folding on a small scale is prevalent, and the axes of the folds vary rapidly in pitch, though horizontal axes nearly parallel to the strike appear to be the most common. The outcrops of the various groups show rapid change

in width in consequence of the pitch of the major fold axes being here to the north-north-east and there to the south-south-west, and probably also because of movement along planes roughly parallel to the strike. For instance, the calcareous group, which is fully 1,000 yds. broad at Fiblister, pitches out at the Taing of Norwick two miles to the north, while the western flaggy quartzite group, half-a-mile wide on the south shore of Quey Firth, disappears to the south-west of Blythot a mile and a quarter along the strike.

The eastern group of flaggy quartzites is separated from both the calcareous group and the foliated igneous rocks by steeply inclined dislocations which are exposed at the Back of Ollaberry and along the west coast of Gluss Voe.

In the ground mapped by Mr. Haldane to the south of Bardister, the only two of the above mentioned groups that can be definitely recognised are the foliated acid and subacid igneous rocks along the east coast, and the calcareous group. Between these there comes a coarse hornblendic gneiss which forms an outcrop about three-quarters of a mile broad, but pinches out near Sullom about 3 miles to the south. To the west of the calcareous group is a thin zone of sheared and altered siliceous schists. A band of graphitic schist exposed on the south shoulder of Clothister Hill contains a considerable mass of iron ore, which on analysis has been found to be practically pure magnetite.

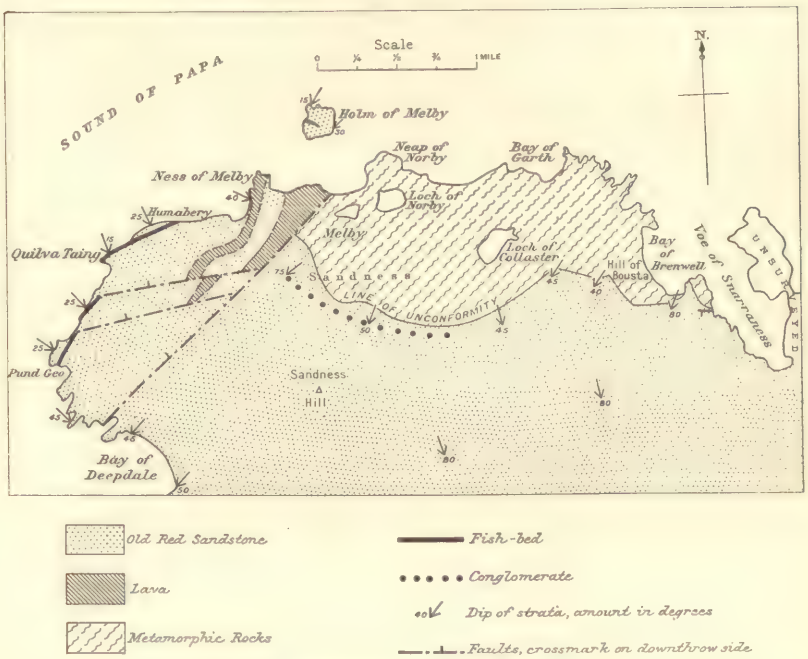
Dr. Robertson finds that in the area surveyed by him the strike of the metamorphic rocks is more or less coincident with the elongation of the islands, and varies from north and south on the west side of Whalsay to east and west in the easternmost of the Out Skerries.

The greater part of Whalsay consists of a garnetiferous kyanite-schist or gneiss, with numerous small granite intrusions, and a belt of permeation gneiss along the east coast. The small islands lying to the east contain phyllitic and quartzitic types which somewhat resemble the less altered rocks on the east side of the Tingwall valley. In the islands between Whalsay and the Mainland more highly altered types appear, and sillimanite schists have been noted.

The rocks of the Out Skerries consist for the most part of schists which are not quite so highly metamorphosed as those in Whalsay, together with a band of crystalline limestone that traverses the islands in an east and west direction. A good deal of granitic injection also occurs, and the affected rocks bear a strong resemblance to those which are found along the eastern margin of the main permeation belt in South Nesting.

In Walls Mr. Wilson and Mr. Knox have noted a very varied selection of rock types including injection gneisses, hornblende-schists, garnetiferous schists, siliceous schists, and calcareous schists with bands of limestone. Although there is a more or less general east and west strike, the rocks are affected by subsidiary folding and slipping to such an extent that as yet it has not been possible to make out any definite order of succession. Mr. Buchan

reports that the metamorphic rocks which form the eastern portion of Foula have a south-westerly strike and consist of a series of silvery schists and gneisses in which muscovite and biotite schists predominate. Garnets are of frequent occurrence and epidote is a common accessory mineral. A certain amount of granitic injection has taken place, and a pink granite, poor in ferromagnesian constituents, that is exposed at Ruscar Head, shows signs of movement since consolidation.



Geological Sketch-map of the Melby District.

Old Red Sandstone.—The mapping of the ground to the west of the Walls boundary fault has shown that a great thickness of siliceous sediment occupies most of the Walls peninsula. In the south and east the beds are invaded by large masses of granitic and dioritic rocks which have indurated the sediments. The degree of hardening diminishes to the north and west, and near Melby some of the later beds are unaltered. The junctions between the igneous rocks and the sediments are very irregular, and numerous strings and veins of granite form a network through the surrounding rocks. An interesting example occurs at the south-east end of Vaila where the cliffs show the roof of the granite, with many offshoots, running both along and across the bedding of the country rock.

The beds are folded and faulted to a marked degree, and the district is divided up into areas in which the strike is either north-west or north-north-east. The faulting is seen to be later than the

folding, and it is not possible to follow the axis of any fold for more than a mile or two. East of the Bridge of Walls a belt of vertical strata about a third of a mile wide can be traced for a distance of about a mile.

The fish remains discovered by Mr. Knox near Melby occur in a band of greyish, limy, often rather sandy flags from 10 to 20 ft. thick, which is exposed at several localities along the coast to the west of Melby (see sketch-map). Fossils, however, are not plentiful, and are usually fragmentary, though individual plates may be in a good state of preservation. From the exposure at the Ayre of Huxter, Mr. W. Fisher was successful in obtaining well-preserved specimens of almost complete fish from some limy nodules in one of the more sandy layers.

On the south-east these beds are cut off from the main Walls Sandstone by a north-east fault which is considered to have a downthrow to the north-west. Beyond this fault the junction between the sandstones and the underlying schistose rocks has been traced as an unconformity for a distance of about 3 miles.

The sediments of Fair Isle and Foula show little of interest. In the Fair Isle they consist of red and grey sandstones with subordinate beds of shale and limestone. In the north pebbly and conglomeratic bands occur, but in the south the rocks are finer grained, more quartzitic and appear to be slightly indurated. The dip is to the south-east at angles varying from 50 to 70 degrees, and as no evidence is known of any important repetition of the succession the total thickness of sediment present would appear to be not less than 8,000 ft. No fossils have been as yet found in the island though limy bands of a promising nature occur in Heukni Geo and at Mather's Head. It is, therefore, on lithological grounds alone that these beds are referred to the Old Red Sandstone.

The sandstones of Foula are softer than those of Fair Isle. They are often massive, current-bedded red and greyish rocks of medium grain with occasional pebbles and thin gritty bands containing angular fragments of coarse red granite and rolled pebbles of vein-quartz and quartzite. The beds are folded into a south-south-westerly pitching syncline and so far the only fossils found have been indeterminate plant fragments from some bands of fissile, micaceous shale.

On the island of Gruney, which lies one mile north of the Point of Fethaland, in the extreme north of Shetland, Dr. Phemister found grits and conglomerates of Old Red Sandstone type lying unconformably on green schists and quartzites. The sedimentary rocks dip to the north-east at about 25 degrees, and their basal layers contain many angular fragments of the underlying rocks.

G. V. Wilson.

Report on Fossil Fish from Sandness, Shetland

By

Professor D. M. S. Watson, F.R.S.

The collection of fossil fish made in the summer of 1933 by Mr. W. Fisher from the neighbourhood of the Loch of Huxter, Sandness, is of importance because it consists of determinable specimens on which a close judgment of horizon may be based. Three different localities are represented, but all lie within ¾ mile and appear to represent a very similar horizon.

Locality 1. *Shore, 1,600 ft. W. 38° S. of Brough at Loch of Huxter,* has yielded remains of at least two individuals of *Homosteus,* of which one is now represented by a very large part of the cranial shield and an associated right anterior dorso-lateral plate. There is no difficulty in making a restoration of the cranial shield of this individual, which can be compared strictly with Traquair's figure of the type of *Homosteus milleri*[1]. Such a comparison shows that very slight differences of proportion exist between the Thurso and the Shetland specimens, the latter being slightly wider and the suture between the external basal and the marginal bones cutting the lateral margin slightly further back. No series of skulls of *Homosteus* exists in London, and only two head shields have been figured, so that the possible range of variation is not known, but I think that there can be no doubt that the Shetland specimen is actually *H. milleri,* with which it agrees in ornament as well as proportions.

Locality 1 has also yielded a single dorso-median plate of a small *Coccosteus,* which agrees in all its main characters with that of *C. decipiens* but differs in that the spine-like posterior prolongation is considerably narrower and longer than in specimens of that species from Lethen Bar. It shows also a rounded bulge at the base of the spine which may be caused merely by the pushing through of the large visceral process which lies below this point. The ornament could not be distinguished from that of *C. decipiens.*

The only other form from Locality 1 is *Pterichthys,* represented by several isolated plates, of which the most important is a left posterior dorso-lateral, seen from its inner surface. This plate makes it clear that the form is a genuine *Pterichthys;* it and the other materials cannot be distinguished by shape, size, or ornament from specimens of *Pterichthys* from the Moray Firth nodules, Achanarras or Orkney.

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[1] Traquair, R.H. '*Homosteus,* Asmuss, compared with *Coccosteus,* Agassiz.' *Geol. Mag.* Dec. III, vol vi., pp. 1-8., Pl. 1. 1889.

Locality 2. *Shore, Ayre of Huxter,* 900 *ft. N.* 15° *W. of Brough at Loch of Huxter,* has yielded many specimens contained in nodules, which very much resemble many of those from Gamrie, Banffshire, or Edderton Burn, Rossshire.

The most abundant fish is a *Diplopterus* of which there are thirteen specimens, none quite complete. These fish are all of much the same size, about 18 to 23 cm. in length. Taken together they show almost the whole external morphology and enable a detailed comparison to be made with other specimens of the genus.

So far as I can see, there are no differences in structure between these fish and Orkney specimens of *D. agassizi,* the proportions of all the bones of the head and trunk and fins seem to be the same and even the number of scale rows is similar; but the size of these Shetland specimens is much less than that of most specimens of *D. agassizi,* which are usually more than 30 cm. long.

From Locality 2 there are ten specimens of a large *Dipterus,* all very badly and incompletely preserved. These all show typical scales of the same very large size, over 1 cm. across. In one or two cases these scales retain cosmine covered regions, a condition unknown in typical *D. valenciennesi* but occurring in *D. platycephalus.* There is one very poor fragment of a head shield comparable with the latter species. On the other hand, one specimen shows well ossified ribs, which I have not seen in *D. platycephalus* although they may have existed in it.

From Locality 2 there are four specimens of a small *Coccosteus,* one of which shows the hinder part of a median dorsal identical with that from Locality 1 referred to above.

These specimens closely resemble *C. decipiens* but are all smaller than most specimens of that species and differ from them in the slender posterior spine of the median dorsal, whilst agreeing in the depth of the visceral process and in ornament.

The only other fish from Locality 2 is a single specimen showing scattered bones and scales of a *Glyptolepis.* Although this is really specifically undeterminable it is indistinguishable from *G. leptopterus* of Lethen Bar, though it might conceivably be a young individual of *G. paucidens.*

Locality 3. *Shore,* 2,720 *ft. S.* 39° *W. of Brough at Loch of Huxter,* has yielded only two specimens, both median dorsals of *Homosteus milleri,* one including also an anterior median ventral.

The fauna of Localities 1 and 2 are tied together by the occurrence in each of a peculiar *Coccosteus* and their age probably does not greatly differ, so that they may be discussed together.

Pterichthys is a genus of Antiarchi known from the nodule localities of the Moray Firth at Gamrie, Tynet Burn, Lethen Bar, Cromarty and Edderton Burn, and in a sandstone at Culloden Moor. In Caithness it is known only from the Achanarras horizon, and in Orkney it is found, though not commonly, in the Stromness beds.

Pterichthys does not occur in the fossiliferous beds, Wick flags, etc., which lie below the Achanarras horizon, nor in the overlying Thurso flags, and it is so characteristic and recognisable a fish that its absence from these beds may be regarded as certain. *Pterichthys* is represented by three species apparently rightly referred to the genus in the Stringocephalus beds of the Middle Devonian of the Rhineland, and by *P. concatenatus* (Eichw.) in the lowest beds Dm 1 and 2 and possibly Dm 3 of the Middle Devonian of the Baltic states[1].

Homosteus is most commonly found in the Thurso beds in Caithness, and especially from the high horizons on the shore to the east of Thurso and at Brims Ness. One specimen has been found in the Achanarras quarry. No trace of *Homosteus* has ever been found in the *Pterichthys* nodules of the Moray Firth; a single specimen from the Hillhead Quarry, Dalcross, is associated with *Coccosteus minor* which is a characteristic fossil of the Thurso beds.

In Orkney Hugh Miller found a bone of *Homosteus* low down in the Old Red Sandstone near Stromness. It seems clear that *Pterichthys* might be expected at this horizon.

In the Baltic lands *Homosteus,* which is there associated with *Heterosteus,* is accordingly to Gross[2], a characteristic fossil of Dm 3, that is, it immediately succeeds the zone of *Pterichthys concatenatus,* which species may perhaps pass up into Dm 3.

Homosteus does not occur in Germany, but its associate *Heterosteus* is there found in the Stringocephalus beds.

It therefore seems clear that *Pterichthys and Homosteus* characterise successive zones and that where, as at Achanarras, Stromness ? and Sandness, they are found together we are dealing with a horizon of limited extent which marks the transition of one to the other zone.

The other forms from Sandness on the whole support this conclusion.

The *Dipterus,* though undeterminable, is more likely to be the Thurso Beds *D. platycephalus* than the lower *D. valenciennesi. D. platycephalus* is rare at Achanarras, *D. valenciennesi* extremely common. It is doubtful if *D. platycephalus* has ever been found in the Moray Firth nodules or in the Stromness beds in Orkney.

The *Coccosteus* of Sandness is of a type with a long range through the Stromness and Rousay beds, and the *Glyptolepis* is indeterminate.

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[1] Gross, W. 'Die Wirbeltiere des rheinischen Devons.' ***Abhd. d. Preussischen Geol. Landes.*** Neue Folge. Heft 154. pp. 1-81. Pls. 1-11. 1933.

[2] Gross, W. 'Die Fische des Baltischen Devons.' *Palaeontographica,* 79. abt. A. 1933.

III. SECTIONAL REPORTS

1. PALAEONTOLOGICAL DEPARTMENT

In London

F. L. KITCHIN, SC.D., PH.D., F.R.S., Palaeontologist (District Geologist).

C. P. CHATWIN, M.SC., Assistant-Palaeontologist (Senior Geologist).

C. J. STUBBLEFIELD, PH.D., A.R.C.SC., Geologist.

In Edinburgh

J. PRINGLE, D.SC., Assistant-Palaeontologist (Senior Geologist).

A. ENGLAND AND WALES

THE general work carried out during the year in this Department has been outlined in the Report of the Director (p. 31). The following few items of interest may be recorded here.

In the course of his work on the palaeontology of the Reigate area, Mr. Chatwin examined the Wealden and Lower Greensand fossils collected in 1899 from the Redhill-Earlswood railway-cutting. At the time when the section was described it was supposed that the Weald Clay was succeeded directly by the Hythe Beds.[1] Comparison with similar material from the same area, however, shows that the usual succession of the Perna Bed overlying the Weald Clay was exposed in this railway-cutting. The junction between the two was sharp, and Mr. Chatwin draws attention to the fact that one of the species of fossils, *Cardium ibbetsoni* Forbes, found in the Perna Bed of this neighbourhood (at Woodhatch) and thought to be restricted to the lowest beds of the Lower Greensand, makes its first appearance at a depth of 25 ft. beneath the top of the Weald Clay, where it is associated with *Viviparus* and *Cyrena*.

The naming by Dr. Stubblefield of an extensive suite of fossils from the Carboniferous Limestone in the western part of Sheet 23 (Cockermouth) has brought out several interesting points. The

[1] 'Summary of Progress for 1900' (*Mem. Geol. Surv.*), 1901, p. 116.

shales towards the base of the series occurring near Blindcrake[1] yield *Aviculopecten* cf. *eskdalensis* Hind and other lamellibranch species, suggesting a possible comparison with the lamellibranch fauna of the Glencartholm shales recorded by B. N. Peach and J. Horne.[2] The resemblance may, however, be due to similar conditions of life and deposition (that is to say, phase) rather than to strict contemporaneity. The Seventh Limestone near Blindcrake contains *Davidsonina* [*Cyrtina*] *carbonaria* (M'Coy) as well as *Composita* cf. *ficoidea* (Vaughan) and other fossils of Subzone S_2. Since this *Davidsonina* is known to occur in the Seventh Limestone of the Egremont district to the south, its apparent absence from the intervening Whitehaven Sheet is truly remarkable.

Assiduous collecting by Mr. S. W. Hester in the shales of the Hensingham Group in Pow Gill in the Cockermouth Sheet has enabled Mr. W. S. Bisat to name specimens of *Anthracoceras glabrum* Bisat and to state that these shales occupy an horizon near that of *Cravenoceras edalense* in the Subzone E_2. From this and neighbouring gills, Dr. Stubblefield has named *Tylonautilus nodiferus* (Armstrong), as well as several other mollusca and some brachiopods specifically identical with forms found in the higher part of the Upper Limestone Group of West Scotland.

A recent boring near Leek, from which fossils and rock-specimens were collected by Mr. A. Templeman, has added to our knowledge of that part of the Churnet Shales which lies within the *Eumorphoceras* Zone. Specimens of indeterminate *Anthracoceras* occur throughout the cores but three levels were encountered at which were found species of the genus *Cravenoceras*; from the uppermost of these (depth 330-332 ft.) were found specimens determined by Mr. Bisat as *C. nititoides* Bisat, and possibly early forms of the same species; Dr. Stubblefield observes that these were associated with *Posidoniella* cf. *vetusta* (J. de C. Sowerby) and a new species of *Actinopteria*. A late form of *Eumorphoceras bisulcatum* Girty was collected from a mottled shale at a depth of 368 ft., and, from cores two feet lower down in the boring, Dr. Stubblefield recognized *C. holmesi* Bisat, which naming has been confirmed by Mr. Bisat. At 430 ft., coarsely ornamented goniatite fragments were found which Mr. Bisat names as *C.* aff. *stellarum* Bisat and *C.* aff. *edalense* Bisat; from near this horizon were collected specimens of *Leiopteria longirostris* Hind, a lamellibranch originally described from the Edale Shales. The boring is scientifically important for it indicates the occurrence of *C. holmesi* between horizons yielding *C. nititoides* and allies of *C. stellarum*.

The work done by Miss M. E. Odell in registering the Geological Society's Collection has enabled Dr. Stubblefield, partly with her co-operation and partly with that of Miss E. Caldwell, of Cambridge, to identify 18 of the specimens figured in Murchison's

[1] Eastwood, T., 'Summary of Progress for 1930,' pt. i (*Mem. Geol. Surv.*), 1931, p. 53.
[2] Peach, B. N., and J. Horne, 'The Canonbie Coalfield,' *Trans. Roy. Soc. Edinb.*, vol. xi, part 4, No. 32, 1903, p. 841.

'Silurian System' which had previously escaped recognition. These include one of the syntypes of *Terebratula navicula* and the holotypes of *Orthis canalis, O. hybrida, Spirifer? pisum, Patella? implicata* and *Asaphus corndensis*.

The following specimens in the Museum have been figured in publications:—

IN THE PALAEONTOGRAPHICAL SOCIETY'S VOLUME FOR THE YEAR 1931.
(Published 1933).

A Monograph of British Corallian Lamellibranchia (Part v).

By DR. W. J. ARKELL, M.A., B.Sc., F.G.S.

Gryphaea dilatata *J. Sowerby*, pl. xxi, figs. 2, 11, p. 160 (2 specimens).
Pteria pteropernoides (*Blake and Hudleston*), pl. xxv, fig. 2, p. 187.
Isognomon *cf.* cordati (*Uhlig*), pl. xxviii, fig. 4, p. 216; and text-fig. 50, p. 209.

IN THE QUARTERLY JOURNAL OF THE GEOLOGICAL SOCIETY, VOLUME LXXXIX.

A Revision of the British Carboniferous Members of the Family Loxonematidae, with Descriptions of new Forms.

By MRS. JANE LONGSTAFF, F.L.S., F.G.S.

Eoptychia tenuistriata (*Portlock*), pl. ix, fig. 1, p. 115 (4 specimens).
Zygopleura redensis *Longstaff*, pl. viii, fig. 8, p. 104.
,, scalaroidea (*Phillips*), pl. ix, figs. 12, 13, p. 97.
,, scalaroidea (*Phillips*), *var.* longnorensis *Longstaff*, pl. ix, fig. 14, p. 98.

On the Occurrence of Tremadoc Shales in the Tortworth Inlier (Gloucestershire).

By DR. STANLEY SMITH, M.A., F.G.S.

With Notes on the Fossils.

By DR. C. J. STUBBLEFIELD, B.Sc., A.R.C.Sc., F.G.S.

Beltella depressa (*Salter*), pl. xxxiv, figs. 1, 9-11, p. 366 (7 specimens).
Niobella [Niobe] homfrayi (*Salter*), *var.* smithi *Stubblefield*, pl. xxxiv, figs. 2-4, p. 368 (5 specimens).
Lingulella *cf.* lepis (*Salter*), pl. xxxiv, fig. 5, p. 365.
Bellerophon (Kokenospira ?) sp., pl. xxxiv, fig. 6, p. 365.
Agnostus calvus *Lake*, pl. xxxiv, figs. 7, 8, p. 366 (2 specimens).
Septadella jackmanae *Stubblefield*, text-fig. 2 (3 views), p. 372.

IN THE MEMOIRS AND PROCEEDINGS OF THE MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY, VOLUME LXXVII.

A Redescription of the known British Silurian Species of Calymene (s.l.).

By MR. J. SHIRLEY, M.Sc., F.G.S.

Calymene blumenbachi *Brongniart*, pl. i, figs. 4, 5, p. 59.
,, nodulosa *Shirley*, pl. i, figs. 6-11, p. 53 (4 specimens).

IN THE JURASSIC SYSTEM IN GREAT BRITAIN.

By DR. W. J. ARKELL, M.A., B.Sc., F.G.S.

Tulites subcontractus (*Morris and Lycett*), pl. xxxv, figs. 3, 3a, p. 275.
Creniceras renggeri (*Oppel*), pl. xxxvii, figs. 4, 4a, p. 610.
Aulacostephanus pseudomutabilis (*de Loriol*), pl. xxxix, figs. 3, 3a, p. 612.
Glaucolithites glaucolithus *S. Buckman*, pl. xl, fig. 2, pp. 481, 514.

IN BRITISH MUSEUM (NATURAL HISTORY).

FOSSIL INSECTS, NO. 3.

The Panorpoid Complex in the British Rhaetic and Lias.

By DR. R. J. TILLYARD, F.R.S., F.L.S., F.G.S., F.E.S., F.N.Z.Inst., C.M.Z.S.

Orthophlebia liassica (*Mantell*), text-figs. 7, 8, 10 pp. 32, 33, 37, 40 (11 specimens).

IN MEMOIRS OF THE GEOLOGICAL SURVEY, ENGLAND AND WALES.

The Geology of the Country around Holmfirth and Glossop, Chapter VII.—*Palaeontology.*

By DR. D. A. WRAY, M.Sc., F.G.S.

Edestus newtoni *A. S. Woodward*, pl. v, figs. 1-10, p. 158.

The Geology of the Country around Torquay.

Second Edition.

Palaeontology.

By MR. C. P. CHATWIN, M.Sc., F.G.S.

Spirifer subcuspidatus *Schnur*, pl. ii, figs. 1-3, 5, p. 22 (4 specimens).
,, incertus *Fuchs*, pl. ii, fig. 4.
,, *cf.* speciosus (*Schlotheim*), pl. ii, fig. 6.
,, speciosus (*Schlotheim*), pl. ii, fig. 7.
,, hercyniae *Giebel*, pl. ii, figs. 8, 9.
,, alatiformis *Drevermann*, pl. ii, figs. 10, 14, 15 (2 specimens).
,, paradoxus (*Schlotheim*), pl. ii, figs. 11-13.

Tropidoleptus rhenanus (*Frech*), pl. iii, figs. 1-3, 6A, 7A, p. 24 (4 specimens).
Stropheodonta murchisoni (*d'Archiac and Verneuil*), pl. iii, fig. 4.
Schizophoria provulvaria (*Maurer*), pl. iii, figs. 5, 9.
Chonetes plebeia *Schnur*, pl. iii, figs. 6B, 7B, 8A (2 specimens).
,, sarcinulata (*Schlotheim*), pl. iii, figs. 6C, 7C, 8B (2 specimens).

IN MEMOIRS OF THE GEOLOGICAL SURVEY. SUMMARY OF PROGRESS OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN AND THE MUSEUM OF PRACTICAL GEOLOGY FOR THE YEAR 1932, Part II.

V.—*The Lower Ordovician Graptolite Fauna with special Reference to the Skiddaw Slates.*

By MISS GERTRUDE L. ELLES, M.B.E., D.Sc., F.G.S.

Didymograptus protobifidus *Elles*, text-fig. 3, pp. 98, 110.
,, extensus (*Hall*), text-figs. 6, 7, pp. 100, 111.
,, praenuntius *Törnquist*, text-fig. 11, pp. 100, 111.
,, deflexus *Elles and Wood*, text-fig. 13, pp. 109, 111.

VI.—*The Fauna of the Palaeozoic Rocks of the Little Missenden Boring.*

By MR. S. H. STRAW, M.Sc., F.G.S.

Cornulites serpularius *Schlotheim*, pl. ix, fig. 1; p. 113 (4 specimens).
Rhopalonaria sp., pl. ix, fig. 2, p. 114 (2 specimens).
Lingula missendenensis *Straw*, pl. ix, figs. 3a, b, p. 114.
,, zigzag *Straw*, pl. ix, figs. 4a, b, p. 115.
Orbiculoidea crucifera *Straw*, pl. ix, fig. 5, p. 115 (2 specimens).
,, sp., pl. ix, fig. 6, p. 116.
Pholidops antiqua (*Schlotheim*), pl. ix, fig. 7, p. 116.
Dalmanella missendenensis *Straw*, pl. ix, figs. 8-10, p. 116 (3 specimens).
Chonetes novascoticus *Hall, var.* missendenensis *Straw*, pl. ix, fig. 11, p. 117 (2 specimens).
Camarotoechia glomerosa *McLearn*, pl. ix, figs. 12, 13, p. 118.
? Ctenodonta hercynica *Beushausen*, pl. ix, fig. 14, p. 119.
? Nucula sp., pl. ix, fig. 15, p. 120.
Palaeoneilo attenuata (*Hall*), pl. ix, fig. 16, p. 120.
Nuculites *cf.* antiqua (*J. de C. Sowerby*), pl. ix, fig. 17, p. 121.
,, *cf.* coarctata (*Phillips*), pl. ix, fig. 18, p. 121.
,, corrugata *Williams*, pl. ix, fig. 19, p. 122.
Modiolopsis *cf.* complanata (*J. de C. Sowerby*), pl. ix, fig. 20, p. 122 (2 specimens).
? Goniophora sp., pl. ix, fig. 21, p. 123.
Anodontopsis sp., pl. ix, fig. 22, p. 123.
Hormotoma *cf.* articulata (*J. de C. Sowerby*), pl. ix, figs. 23, 24, p. 124 (2 specimens).
Hormotoma missendenensis *Straw*, pl. ix, fig. 25, p. 124 (4 specimens).
Plectonotus trilobatus (*J. de C. Sowerby*), pl. ix, figs. 26, 27, p. 125.
Tentaculites annulatus *Schlotheim*, pl. x, figs. 1a, b, 2, p. 125 (2 specimens).
Kionoceras angulatum (*Wahlenberg*), pl. ix, figs. 28a, b, p. 126 (2 specimens).
Orthoceras *cf.* bullatum *J. de C. Sowerby*, pl. x, fig. 3, p. 126.
,, *cf.* imbricatum *J. de C. Sowerby*, pl. x, fig. 4, p. 127.
,, ludense *J. de C. Sowerby, var.* granulatum *Straw*, pl. x, figs. 5a, b, p. 127 (2 specimens).

Calmonia sp., pl. x, figs. 6, 7, p. 127 (2 specimens).
Phacops sp., pl. x, fig. 8, p. 128 (2 specimens).
? Dalmanites sp., pl. x, fig. 9, p. 129.
Beyrichia noetlingi *Reuter*, pl. x, figs. 10-12, p. 129 (3 specimens).
Kloedenia wilckensiana *(T. R. Jones)*, pl. x, fig. 13, p. 130.
Cytherellina siliqua *(T. R. Jones)*, pl. x, fig. 14, p. 131.
Aparchites oblongus *(Jones and Holl)*, pl. x, fig. 15, p. 131.
Haploprimitia sp., pl. x, fig. 16, p. 132.

Report on the Fish-remains from the Little Missenden Boring.

By Sir Arthur Smith Woodward, LL.D., F.R.S., F.L.S., F.G.S.

Climatius sp., pl. x, figs. 17-20, pp. 133, 140 (20 specimens).
Psammosteus sp., pl. x, figs. 21, 22, pp. 133, 140 (3 specimens).

In Skrifter om Svalbard og Ishavet, No. 52. Oslo, 1932.

The Downtonian and Devonian Vertebrates of Spitzbergen.

IV.—*Sub order Cyathaspida.*

By the late Professor Johan Kiaer.

Edited by Mr. A. Heintz.

Cyathaspis banksi *Lankester*, pl. viii, figs. 1, 2, pp. 21, 22 (2 specimens).

Specimens from the Palaeontological Department have also been described or mentioned in the following publications:—

In the Palaeontological Society's Volume for the Year 1931.

A Monograph of the Ammonoidea of the Gault. (Part x). By Dr. L. F. Spath, F.G.S.

In the Geological Magazine, Volume LXX.

Notes on the Species *Illaenus bowmanni* Salter. By Dr. F. R. Cowper Reed, M.A., F.G.S.

In the Proceedings of the Geologists' Association, Volume XLIV.

Summer Field Meeting, 1932; Girvan-Ballantrae. Appendix A.—On three Trilobites from Girvan. By Mr. Alan Wood, B.Sc.
The Sandgate Beds of the Western Weald, By Mr. J. F. Kirkcaldy, M.Sc., F.G.S.
The Lower Oolites exposed in the Ardley and Fritwell railway cutting between Bicester and Banbury, Oxford. By Dr. W. J.

Arkell, M.A., B.Sc., F.G.S., Mr. L. Richardson, F.R.S.E., F.G.S., and Dr. J. Pringle, F.R.S.E., F.G.S.

In the Proceedings of the Bristol Naturalist Society, Volume VII, Fourth Series.

On the Occurrence of the D_3-Subzone in the Mendip Area. By Dr. F. B. A. Welch, B.Sc., F.G.S.

In the Proceedings of the Leeds Philosophical Society, Volume II.

Early and Mid-Carboniferous Earth Movements in Great Britain. By Dr. R. G. S. Hudson, F.G.S., and Mr. J. Selwyn Turner, B.Sc., F.G.S.

B.—Scotland

During the year Mr. D. Tait has examined several interesting sections temporarily exposed in the city of Edinburgh. One of these, made in the Cowgate, was excavated on the side of the street opposite the spot where Bennie many years ago obtained numerous plant-remains from the superficial deposits. In view of their renewed interest Bennie's specimens, which had never been determined, have been submitted to Mrs. Clement Reid and Professor T. Johnson, and their report on the flora will be incorporated in a paper which is being prepared by Mr. Tait.

From the cores of a boring made in search of water at Messrs. Bartholomew's works in Duncan Street, Mr. Tait collected a number of plants from grey shales at present included in the Upper Old Red Sandstone. Among the specimens submitted for determination Dr. R. Crookall has recognized *Alcicornopteris convoluta* Kidston, a species commonly found in the Calciferous Sandstone Series.

In addition to his work of bore-inspection Mr. Manson again visited the sections of chalk on Ben Iadain in Morvern, and secured a number of fossils. His collection includes an example of *Salenia geometrica* Agassiz, a characteristic fossil of the Zone of *Belemnitella mucronata*. The find therefore confirms the view held by the late Professor Judd, who regarded the Morvern Chalk as belonging to this zone.

While in the neighbourhood, Mr. Manson took the opportunity to visit a locality in Mull and collect from a small exposure in a burn flowing into Duart Bay, near Torosay Castle. The beds had previously yielded poorly-preserved fragments of ammonites, which the late S. S. Buckman thought bore a resemblance to species of *Cosmoceras* and *Reineckeia*. It was understood, however, that on account of their condition the tentative naming might have to

be modified if better material were forthcoming. Dr. L. F. Spath, on the other hand, recognized that the material included species of *Amoeboceras* and *Rasenia*, and therefore indicated a Kimmeridge age for the beds. Mr. Manson was successful in obtaining several well-preserved fragments of ammonites which Dr. Pringle has identified as *Amoeboceras kitchini* Salfeld, *Pararasenia* cf. *lepidulus* (Oppel) and *Rasenia sp.* These ammonite species indicate that the strata fall within the Zone of *Rasenia mutabilis*, and their evidence is therefore in full accord with Dr. Spath's allocation of the beds to the Kimmeridge formation.

Further collecting was made by Dr. M. Macgregor and Mr. Manson from the interesting patch of Coal Measures which is preserved on the north shore of the Sound of Mull at Inninmore, and the results of their work are embodied in a paper which will appear in Part II of the present *Summary of Progress*.

In the Southern Uplands, Mr. Eckford has collected a series of graptolites from several localities between the Clyde and the Nith and it is hoped that a study of these fossils will throw light on the horizon of a widespread volcanic episode in the Ordovician. Along the Border country Dr. Pringle spent several weeks in the revision of certain areas in connexion with the issue of a new edition of Sheet 17.

An interesting and important suite of fossil fish from the Old Red Sandstone exposed on the coast west of Melby, Sandness, in the Shetland Islands, was obtained by Mr. Fisher, acting under the direction of Mr. J. Knox. The specimens, which include species of *Coccosteus, Homosteus, Pterichthys,* etc., have been sent to Professor D. M. S. Watson, F.R.S., for study, and in a preliminary report he states that the fauna is closely related to that of the Stromness Beds of Orkney and the Achanarras horizon of Caithness (see p. 74).

The registration of the John Smith Collection has now been completed by Mr. E. M. Anderson. Over 20,300 specimens have been numbered and entered in the departmental registers. He has also prepared a card-index of localities, which will render the collection easy of access to members of the staff and research students. A large number of types and figured specimens which were included in the collection have been mounted and are ready to place on exhibition in the Survey Collections in the Royal Scottish Museum.

The following specimens have been figured in publications:—

IN THE QUARTERLY JOURNAL OF THE GEOLOGICAL SOCIETY, VOLUME LXXXIX.

A Revision of the British Carboniferous Members of the Family Loxonematidae, with Descriptions of new Forms.

BY MRS. JANE LONGSTAFF, F.L.S., F.G.S.

Zygopleura benniana *Longstaff*, pl. viii, figs. 9-12, p. 102.
,, robroystonensis *Longstaff*, *var.* tenuicostata *Longstaff*, pl. xii, figs. 8, 9, p. 102.
,, roscobiensis *Longstaff*, pl. viii, fig. 13; pl. xii, fig. 7, p. 99.
,, rugifera (*Phillips*), pl. vii, fig. 14, p. 92.
,, ,, *var.* cylindracea *Longstaff*, pl. vii, figs. 10, 11, 17, p. 94.
,, ,, *var.* minima (*J. de C. Sowerby*), pl. vii, fig. 15, p. 93.
,, ,, *var.* rowlandsi *Longstaff*, pl. vii, fig. 5, p. 95.
Hemizyga clathratula (*Young and Armstrong*), pl. xi, fig. 2, p. 106.
Katosira smithiana *Longstaff*, pl. xi, figs. 6-8, p. 105.
Platyconcha tenuilineata *Longstaff*, pl. xi, fig. 11, p. 117.
Microptychis pygmaea *Longstaff*, pl. xii, figs. 1-3, 3a, p. 111.
Knightella irregularis *Longstaff*, pl. xii, figs. 4-6, p. 119.

IN THE ANNALS AND MAGAZINE OF NATURAL HISTORY, VOLUME XI, TENTH SERIES.

On Anthracocaris scotica (*Peach*), *a Fossil Crustacean from the Lower Carboniferous.*

By DR. W. T. CALMAN, F.R.S., F.L.S., F.Z.S.

Anthracocaris scotica (*Peach*), text-fig. 1, p. 564.

F. L. KITCHIN.

2. PALAEOBOTANICAL WORK

FOSSIL plants have been identified during the year from thirteen one-inch Sheets in England, namely, 10 (Woodhorn), 19 (Hexham), 23 (Cockermouth), 75 (Preston), 84 (St. Helens), 87 (Barnsley), 167 (Dudley), 245 (Pembroke and Tenby), 264 (Bristol), 273 (Faversham), 289 (Canterbury), 290 (Dover), 292 (Bideford), and from four one-inch Sheets in Scotland, namely, 15 (Sanquhar), 32 (Edinburgh), 52 (Argyll) and 125 (Foula). Miscellaneous identifications of plants have been made for the Palaeontological Department, Mr. L. G. G. Warne, of Bristol, Mr. James Walton of Brighouse, Mr. F. R. Browning of the Haslemere Museum, Prof. W. G. Fearnsides, Dr. R. G. Absalom of the Kelvingrove Museum, Glasgow, Mr. J. E. Jones, Manager of Chislet Colliery, near Canterbury and Mr. J. Prior, of Hersden School, near Canterbury.

The major portion of the Palaeobotanist's time has been devoted to Museum work, the chief item consisting in the preparation of the Regional Exhibit illustrating the geology of the Bristol district. In this work assistance has been received from Dr. F. B. A. Welch, and about half of the exhibit is completed. In addition, the Palaeobotanist has continued to assemble the Coal Exhibit and has selected plant specimens for certain Regional Exhibits and for the Stratigraphical Exhibit. The Fuel Research Department has again given help by providing specimens of coals, etc., for various exhibits.

The curating of the Kidston collection continues to occupy considerable time, as the specimens are much consulted by research workers.

Additional specimens of fossil plants were obtained during the Palaeobotanist's visits to the Kent coalfield, and the number of selected specimens from the area, preserved in the Museum of Practical Geology, now exceeds 1,000. The recent visits brought to light examples of *Sigillaria brardi* Brongniart, an important Upper Coal Measures form, fructifications of Pteridosperms and the *Spiropteris* condition of *Alethopteris serli* (Brongniart). A number of fossil animals were also obtained, and especially insect wings. The number of insect wings now obtained from the Kent Coal Measures probably equals that from any other British coalfield.

A specimen of petrified wood from a conglomerate in the No. 21 Level at Chislet Colliery, Sturry, near Canterbury, was sectioned and proved to be *Dadoxylon*. This constitutes the first record of a petrified plant from the Kent coalfield.

Specimens of *Alcicornopteris* were collected by Mr. David Tait from a boring in Duncan Street, Edinburgh. This genus is known only from the Calciferous Sandstone Series in Scotland, and

chiefly from the Oil Shale Group. The records are of importance since the specimens were obtained from rocks mapped as Upper Old Red Sandstone.

The identification of certain plants collected by Messrs. Eckford and Pringle from the Polneul Burn, near Kirkconnel, proved to be of great help in determining the age of a marine band in the section exposed in that stream. The plant-bed lies some 12 ft. below marine shales and ironstones containing a fauna which, in the absence of other criteria, would have justified the inclusion of the beds in the Lower Carboniferous. The plants obtained include *Calamites, Sphenophyllum, Alethopteris lonchitica* (Schlotheim), *Neuropteris schlehani* ? Stur and *Cordaites,* indicating that the marine bed is of Upper Carboniferous age.

Pieces of petrified wood were sent in for examination by C. W. Hobley, Esq. from the Fullers Earth Beds at Cockley Pit, Redhill, Surrey. Sections prepared from these fragments were identified by Dr. E. H. B. Boulton, Cambridge, as *Cupressoxylon,* and most probably as a species of Juniper. The record is new from that locality and appears to be new from that horizon. Other petrified woods have been examined by the Palaeobotanist from Portland and from Australia.

The following specimens, preserved in the Kidston Collection, have been figured, described or mentioned in publications:

IN THE TRANSACTIONS OF THE ROYAL SOCIETY OF EDINBURGH, VOLUME LVII.

Contributions to the Study of the Old Red Sandstone Flora of Scotland VIII. *On* Arthrostigma, Psilophyton, *and Some Associated Plant-remains from the Strathmore Beds of the Coledonian Lower Old Red Sandstone.*

By PROFESSOR W. H. LANG, F.R.S.

Arthrostigma gracile *Dawson* pl. 1, fig. 1, p. 493 (No. 7215)
,, ,, ,, p. 493 (No. 493)
Psilophyton princeps *Dawson* pl. 2, fig. 17, p. 493 (No. 7216)
,, ,, ,, pl. 2, fig. 18, p. 493 (No. 7217)
,, ,, ,, pl. 2, fig. 21, p. 493 (No. 7222)
,, ,, ,, pl. 2, fig. 34, p. 493 (No. 7224)
,, ,, ,, pl. 2, fig. 35, p. 493 (No. 7227)
Psilophyton sp., p. 494 (Nos. 6795, 6796, 7224-7)
Dichotomous axes, p. 493 (Nos. 7043, 7044, 7216-20)

R. CROOKALL.

3. PETROGRAPHICAL WORK

PETROGRAPHICAL work in connexion with the areas being surveyed has been proceeded with by the Petrographer and staff as far as the preparation of exhibits and other exceptional duties related to the new Museum would allow. The Petrographer has dealt with collections from the Borrowdale Volcanic Series, the Eskdale Granite and other rocks from the Lake District. He has been called into consultation with the Home Office on the interpretation of the Workmen's Compensation Act (Silicosis Scheme), and with the Committee of the Medical Research Council appointed to consider industrial pulmonary disease. He was also consulted by the Building Research Laboratory on the petrographical nature of certain dolerites and the influence of the mineral chlorophaeite on concrete-aggregates, and on the nature of a dust-fall by the Meteorological Office.

The number of scientific enquiries has been very large. The Petrographer has investigated the nature of prehistoric pottery from Richborough (Kent), and Meon Hill; has identified iron slags (magnetite-fayalite) from prehistoric sites in Skye; and named the material used respectively in the fabric of Winchelsea Church (Caen Stone), Barton Church (Clipsham Stone), Ockham Church (Reigate Beds), the Roman Wall of London (Kentish Rag), and the west gate of Verulamium (Great Oolite of Oxfordshire).

The examination of stone implements from Rathlin I., Co. Antrim, Ireland, proved them to be made of fused aluminous sediment (buchite) which is apparently of local origin, but the mode of occurrence of the buchite has yet to be determined. A report was also issued to the Southern Railway Co. on the nature (Portland Stone) and durability of the material used in the construction of St. Paul's railway bridge over the Thames.

Two interesting cases of the substitution of sea-borne merchandise have been brought to the Petrographer's notice. For a consignment of cut-glass from Antwerp to Swansea blocks of Kentish Rag had been substituted; and a consignment of cigars from Rio de Janeiro to the Port of London had been replaced by freshly quarried blocks of a pale garnetiferous gneiss which the Petrographer identified as coming from the Gloria district of Rio. Both substitutions were undoubtedly accomplished at the place of export.

Scotland

In connexion with the new colour-printed edition of One-inch Sheet 17 (Jedburgh), Dr. J. Phemister has examined the collection of sliced igneous rocks with a view to bringing the lettering on this Sheet into conformity with the other recently-published One-inch Sheets of the Southern Uplands. Mr. A. G. MacGregor has continued his work on the igneous rocks of One-inch Sheet 14

and has carried out a classification of the igneous rocks in the north-western half of One-inch Sheet 15, a new edition of which is to be published shortly. Mr. MacGregor has also supervised the collection and registration of museum specimens from One-inch Sheet 52 and has selected from this material certain rocks for analysis.

Dr. Phemister and Mr. MacGregor have examined several collections furnished by the Royal Commission on Ancient Monuments from " burnt mounds " in Shapinsay and Bressay and at Moniaive with a view to identifying the stones in the mounds and determining whether they have been subjected to the action of fire. Criteria for the recognition of " burning " were suggested and and have been accepted for publication by the Commission.

The Director has contributed a chapter on the igneous rocks to the Memoir on ' The Geology of the Orkneys,' now in the press.

HERBERT H. THOMAS.

4. CHEMICAL WORK

THE quantitative analyses completed during 1933 included rocks for the memoirs on Shetland, Orkney, Whitehaven (One-inch Sheet 23) and Argyll (One-inch Sheet 52); a selection of these is given below :—

946. *Tonalitic Granodiorite.* Outer member of plutonic intrusive complex (Morvern-Strontian Granite Complex). In burn 900 yds. W. 30° S. of Bellsgrove Lodge (at the site of the old Middleshope Mine). Six-inch map, Argyll, 28 N.W. Slice No. S 28448.

947. *Granodiorite-porphyry.* Broad dyke or sheet cutting granodiorite of Morvern-Strontian Granite Complex. Coast, 300 yds. N. of Eilean a' Mhuirich. Six-inch map, Argyll, 27 S.E. Slice No. S 28450.

Lab. Nos.	956*	957	958	959	960	961	962
SiO_2	36.61	39.22	34.93	75.88	76.13	61.99	76.20
Al_2O_3	10.27	9.71	10.08	11.19	11.21	17.41	11.03
Fe_2O_3	3.84	7.66	4.57	2.44	1.66	1.85	1.58
FeO	5.81	6.83	6.05	1.10	1.45	2.44	1.45
MgO	12.04	10.11	12.20	0.15	0.11	2.32	0.12
CaO	14.14	12.80	14.12	0.44	0.25	4.79	0.20
Na_2O	1.84	1.37	2.00	4.04	4.30	5.68	4.90
K_2O	2.00	1.66	1.25	4.39	4.39	1.82	4.39
$H_2O > 105°C$ ...	3.81	2.11	3.48	0.12	0.13	0.63	0.14
$H_2O < 105°C$ ...	0.79	0.89	1.13	0.07	0.04	0.08	0.05
TiO_2	3.74	4.24	2.80	0.31	0.28	0.84	0.24
P_2O_5	1.41	1.24	1.93	0.00?	0.17	0.36	0.15
MnO	0.16	0.16	0.24	0.06	0.06	0.06	0.05
CO_2	3.14	1.98	4.93	0.00	0.00?	0.00?	0.00?
FeS_2	0.33	0.20	0.51	—	—	—	—
Cr_2O_3	0.07	0.09	0.06	—	—	—	—
BaO	0.14	0.04	0.10	—	—	—	—
Li_2O	0.00?	0.00?	0.00?	—	—	—	—
Totals	100.14	100.31	100.38	100.19	100.18	100.27	100.50
Analysed by	B. E. Dixon.						

*SrO, trace.

948. *Fine-grained dioritic rock,* cut by granodiorite-porphyry dyke and probably enclosed in granodiorite of the Morvern-Strontian Granite Complex. Coast, 300 yds. N. of Eilean a' Mhuirich. Six-inch map, Argyll, 27 S.E. Slice No. S 28456.

949. *Granodiorite.* Member of plutonic complex intervening between an outer tonalite and an inner granite (Morvern-Strontian Granite Complex). Quarry, 300 yds. E.N.E. of Eilean a' Mhuirich. Six-inch map, Argyll, 27 S.E. Slice Nos. S 28449 and S 28738.

944. *Granophyre* of the Carrock Fell Complex. 600 yds. E. of 2174 (of one-inch map), Carrock Fell. Six-inch map, Cumberland, 48 S.W. Slice No. E 16184.

945. *Felsite* of the Carrock Fell Complex. Dump from old level at head of Long Grain, 550 yds. W. 34° S. of △ 2157 (of one-inch map) at summit of High Pike. Six-inch map, Cumberland, 47 S.E. Slice No. E 16185.

P.1. *Titanaugite.* Small patch or segregation within a xenolith in the Haddo norite Schivas, N.E. Aberdeenshire.

956. *Biotite-monchiquite.* Dyke cutting Old Red Sandstone. Rennibuster Point, ¼ mile N. of Rennibuster Farm, Firth, Orkney. One-inch map, Scot., 119. Slice No. S 29635.

Lab. Nos.	946	947	948	949	944	945	P. 1
SiO_2	66.58	68.83	63.70	63.53	73.17	67.37	37.52
Al_2O_3	14.84	14.29	15.10	16.08	12.95	17.94	14.29
Fe_2O_3	0.15	0.84	1.14	1.39	1.45	0.56	4.43
FeO	2.94	1.72	3.10	2.54	2.06	1.86	7.12
MgO	2.22	1.60	2.73	2.58	0.08	2.55	6.72
CaO	3.58	2.78	4.24	4.08	1.30	0.73	24.06
Na_2O	4.48	4.35	4.26	4.64	4.37	2.14	0.09
K_2O	2.87	3.88	3.52	3.43	3.67	4.39	0.00?
$H_2O>105°C$ ...	0.68	0.48	0.30	0.45	0.43	2.15	0.00
$H_2O>105°C$ ...	0.14	0.08	0.06	0.07	0.14	0.15	0.00
TiO_2	1.04	0.79	1.23	1.14	0.39	0.07	5.72
P_2O_5	0.49	0.65	0.42	0.41	0.07	0.07	—
MnO	0.05	0.07	0.07	0.06	0.11	0.03	0.14
CO_2	0.00?	0.00?	0.00?	0.00?	0.10	0.10	—
FeS_2	0.18	0.09	0.09	0.09	0.00	0.08	—
Cr_2O_3	—	—	0.00?	—	—	—	0.11
Totals	100.24	100.45	99.96	100.49	100.29	100.19	100.20
Analysed by	B. E. Dixon.						

957. *Monchiquite.* Dyke cutting Old Red Sandstone. Ward Holm, Copinshay, Orkney. One-inch map, Scot., 118. Slice No. S 29636.
958. *Biotite-monchiquite.* Dyke, Naversdale, in burn, Orphir, Orkney. One-inch map, Scot., 119. Slice Nos. S 15185 and S 29648.
959. *Brown Felsite,* eyed type. Dyke cutting granite 1,050 ft. 31° S. of W. of outflow from Mill Loch, North Roe (on Beorgs of Uyea). Six-inch map, Shetland, 14 N.E. Slice No. S 29703.
960. *Granophyric Riebeckite-felsite,* porphyritic, spherulitic type. Dyke cutting granite. Beorgs of Uyea, due W. of Mill Loch, North Roe. Six-inch map, Shetland, 14 N.E. Slice No. S 29704.
961. *Albite-orthogneiss.* Grut Ness, 1⅛ m. E. of Uyea. Six inch map, Shetland, 9 S.E. Slice No. S 29706.
962. *Granophyric Riebeckite-felsite.* Dyke cutting granite. Beorgs of Uyea, due W. of Mill Loch, North Roe. Six-inch map, Shetland, 14 N.E. Slice No. S 29707.

No. P.I., described by Dr. Kennedy, is characterised by its high titanium, considerably higher than in any titaniferous augite yet reported, and by its low silica. The optical properties and the chemical composition of the titaniferous pyroxenes in general have been discussed[1].

B. E. Dixon.

[1] 'Optically Uniaxial Titanaugite from Aberdeenshire,' B. E. Dixon and W. Q. Kennedy, *Zeit f. Krist.*, vol. lxxxvi, 1933, pp. 112-120.

IV. MUSEUM OF PRACTICAL GEOLOGY

THE total number of visitors for the year was 20,764; of these 1,428 were Sunday visitors. Seven demonstrations were given to parties from Colleges and Scientific Institutions, the total attendance at these being 250.

The occupation of the new building at South Kensington by the World Economic Conference entailed some alteration in the programme of equipping the New Museum but steady progress has been made with the preparation of the new exhibited collections. Models, dioramas, large-scale maps, and pictorial restorations illustrating such subjects as glaciation, vulcanicity, the occurrence and working of iron ore and building stones, have been put in hand and in several cases carried to completion. The exhibits illustrating economic geology and the regional geology of Great Britain have been in active preparation throughout the year and a large number of printed labels have been delivered.

For the first time in its long history the museum suffered loss by burglary. On the night 24th-25th August a case was broken open by someone who had secreted himself behind the scaffolding supporting the roof and who succeeded in escaping with a number of valuable specimens. About one half of these were subsequently traced by the police and restored to the collections. In connexion with the burglary a man was put on trial on November 21st at the Old Bailey, convicted of receiving the specimens, and sentenced to 17 months' imprisonment with hard labour.

In conformity with normal practice, exhibits illustrating recent Survey work were prepared for the British Association meeting at York and for the Annual Conversazione of the Geologists' Association at Leicester. A similar exhibit was also prepared for the Fuel Exhibition held at Cardiff.

The Library has been consulted by approximately 4,000 outside readers during the year. Accessions comprise 237 volumes of independent works, 183 pamphlets, 3,062 volumes and parts of serials and 248 maps. There were supplied to public order 390 prints of geological photographs and 680 lantern slides.

W. F. P. McLintock.

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